DOCUMENT RESUME

ED 373 902 PS 022 644

TITLE	Tree Amigos.
INSTITUTION	Center for Environmental Study, Grand Rapids, MI.
PUB DATE	93
NOTE	436p.
AVAILABLE FROM	Center for Environmental Study, 143 Bostwick NE, Grand Rapids, MI 49503 ($25 includes shipping and handling).
PUB TYPE	Guides - Classroom Use - Instructional Materials (For Learner) (051) -- Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC18 Plus Postage.
DESCRIPTORS	*Conservation (Environment); Cultural Awareness; Cultural Exchange; *Ecology; Elementary Secondary Education; *Environmental Education; *Forestry; Global Approach; Instructional Materials; *Intercultural Programs; Land Use; Learning Activities; Natural Resources; Preschool Education; Program Implementation; Recycling; Resource Materials
IDENTIFIERS	*Environmental Awareness; Environmental Issues; Environmental Protection

ABSTRACT

Tree Amigos is a special cross-cultural program that uses trees as a common bond to bring the people of the Americas together in unique partnerships to preserve and protect the shared global environment. It is a tangible program that embodies the philosophy that individuals, acting together, can make a difference. This resource book contains projects, activities and resources that can be used in the classroom and in community programs. The first section, "Tree Amigos Action Projects," contains ideas, strategies, and success stories of Tree Amigos programs. It also contains forms, logo sheets, and other materials that can be duplicated. The second section, "Learning Activities," contains activities for all age levels that can help reinforce concepts related to action projects involving a classroom, school, or community. The activities are grouped into five categories: (1) trees; (2) ecosystems; (3) land use; (4) people and resources; and (5) reduce, reuse, and recycle. Materials in the third section, "Background Learning for Teachers," provide information about a variety of subjects that can be related to the action projects and learning activities. Some may serve as hand-outs for advanced junior high and high school students. The final section, "Resources," contains materials for promoting and implementing a Tree Amigos program. The resources include bibliographies, video lists, reference lists, and other materials. (TJQ)

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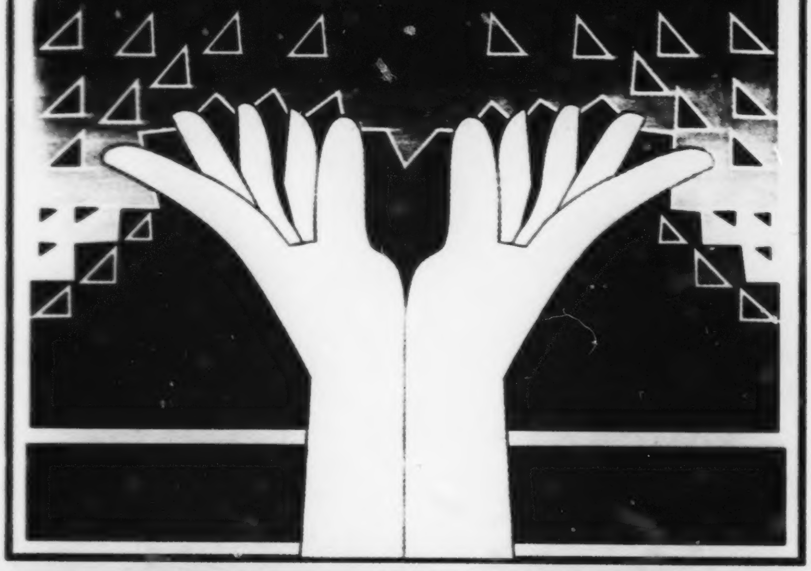

AMIGOS™

Center for Environmental Study
Centro de Estudio Ambiental

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Center for Environmental Study • Centro de Estudio Ambiental

TREE AMIGOS

*Welcome to **Tree Amigos!** Bienvenido a **Tree Amigos!***

On behalf of the Center for Environmental Study and the Centro de Estudio Ambiental Boards and staff, I am pleased to invite you to become a partner in the **Tree Amigos** program.

Tree Amigos are young people and young-at-heart people. They are people who are learning about being stewards in the environment -- from the second-grader saving "Pennies for Pythons" to preserve acres of rainforest, to junior high students "Adopting an Iguana" in a sustainable development partnership; from teachers and students planting trees with campesinos (farmers) in Latin America to a classroom purchasing a globe or constructing a one-room school on the Guaymie Indian Reserve in Costa Rica.

Tree Amigos provides an opportunity for individuals and groups, classrooms and board rooms to become partners in the protection, preservation and restoration of our shared global resources. **Tree Amigos** is not a curriculum or highly structured program, rather it is a framework within which students, teachers or entire schools design activities for their own special needs. It is hoped that nationally-recognized **Tree Amigos** partnerships and complementary resources will help you develop your own **Tree Amigos** program.

Thanks to start-up grants from the Grand Rapids Foundation, Wege Foundation and the Steelcase Foundation, this resource book has been designed to grow with **Tree Amigos**. Through the **Tree Amigos** program, our goal is to improve environmental literacy and provide concrete ways we all can become "*...partners for a better world.*"

Sincerely,

Kay T. Dodge

Kay T. Dodge, Ph.D.
President

CENTER FOR ENVIRONMENTAL STUDY • TREE AMIGOS PROJECT
143 Bostwick NE • Grand Rapids, MI 49503 • (616) 771-3935 • FAX (616) 771-4005

ACKNOWLEDGEMENTS

The Center for Environmental Study would like to thank all of our **Tree Amigos** for their help to create and develop our **Tree Amigos** Resource Book. Of special note, we want to recognize:

Wege Foundation
Grand Rapids Foundation
Steelcase Foundation
Grand Rapids Community College
Grand Rapids Public Schools
Peter M. Wege
D & W Food Centers, Inc.
Coleman & Associates
John A. Waters, Waters & Morse, P.C.
Michigan Geographic Alliance
Pete Van Enk
Lori Heeren
Ruben Juarez
Emily Smith
Stephanie Keller
Ngan Bui
Laurie Zimmerman
Bob and Kathy Coleman
Sarah Reagan
Terri Thieme
Mike Libbee, Ph.D.
Ivette Acevedo

All of our **Tree Amigos** Teachers, Schools and Friends

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DEDICATED TO PETER M. WEGE, One of the World's Best Tree Amigos

WHAT TREE AMIGOS CAN DO FOR YOU!

- *Promote an understanding of complex ecological concepts by using students' personal experiences and concrete, easily observable examples.*
- *Provide activities to strengthen students' scientific skills including observation, data collection, interpretation and prediction.*
- *Show the interconnections between components of the environment and show how a change in one part of the system can affect the rest of that system.*
- *Emphasize how humans fit into the natural world, how we've taken advantage of our world, and how we can make changes to help save it.*
- *Help to consider the concepts covered in a global perspective in order to enlarge students' world views.*
- *Broaden students' knowledge of geography and ecology.*
- *Provide students with a cross-cultural experience to gain new perspectives, meet new friends and have fun learning!*

Welcome to the Tree Amigos Resource Book!

This notebook has been developed to help you involve your students in action-oriented activities related to environmental concepts and issues. It is designed not as a curriculum but as a supplementary resource for you to use in developing learning units, projects, and programs.

Tree Amigos *can provide you with a unified theme to touch on all subject areas, with projects and activities relating to environmental science, language arts, social studies and other areas. This resource notebook provides examples of action projects, background content material, learning activities to reinforce concepts related to action projects, references and other useful materials.*

In addition to those materials designed specifically for the ***Tree Amigos*** *Project, materials for this notebook have been collected from sources throughout this country, including both governmental and private agencies. Most materials have been used extensively by educators and hence have been field-tested and proven successful. A resource listing has been provided for each item. Please include this reference when you reproduce the materials.*

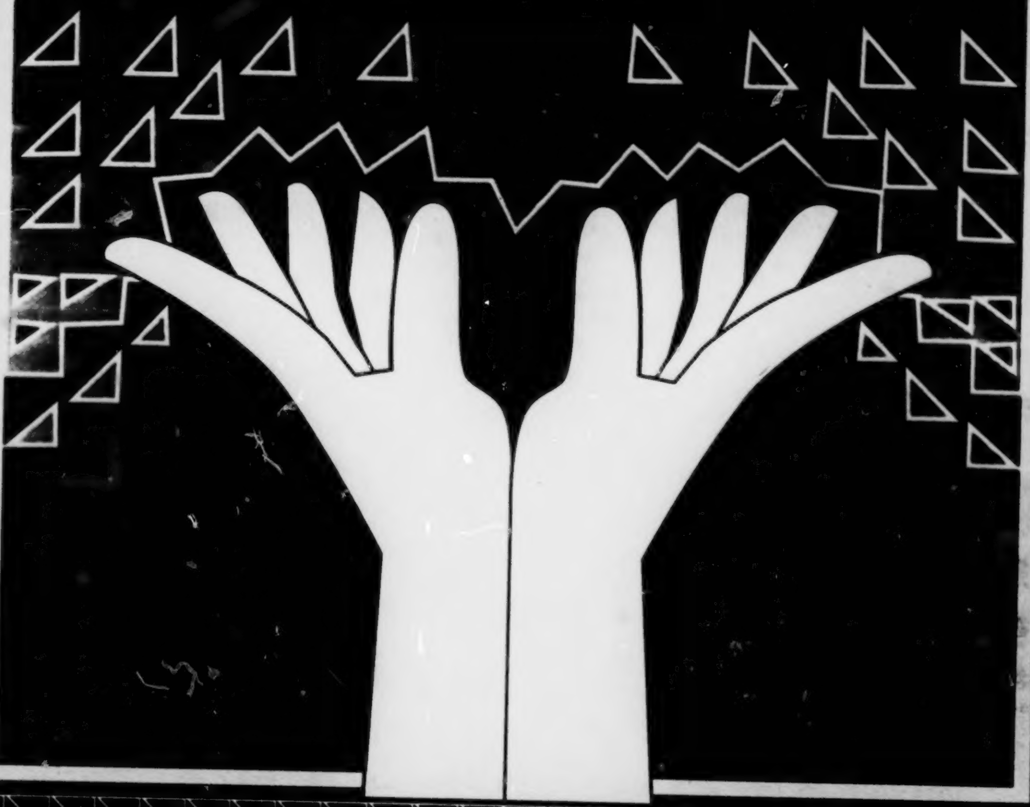
The ***Tree Amigos*** *Resource Book is designed to involve you in a continuous and dynamic process. So keep in touch! We would like to hear from you about your experiences with this notebook and the action projects which you undertake. Tell us what worked for you, and what didn't work. As you create your own* ***Tree Amigos*** *activities and projects, share them with us so we can pass them along. As we find new and useful materials, we'll make sure we send them on to you as part of our network of* ***Tree Amigos*** *teachers here and in Latin America.*

The developers and supporters of the ***Tree Amigos*** *Resource Book applaud your efforts to help our children understand the many complicated concepts and problems that will confront them as we move toward the 21st century. We wish you success!*

THE CENTER FOR ENVIRONMENTAL STUDY

&

TREE AMIGOS



THE CENTER FOR ENVIRONMENTAL STUDY & TREE AMIGOS

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WHAT IS THE CENTER FOR ENVIRONMENTAL STUDY?

The Center for Environmental Study is a non-profit organization devoted to helping preserve and enhance the quality of the global environment through education, communication and research.

Among its goals, the Center:

- Brings people together to define, translate, and analyze problems and explore solutions
- Promotes, facilitates and participates in environmental education
- Serves as a resource center for environmental information
- Encourages and translates environmental research

Founded in 1969, the Center is one of the environmental leaders in West Michigan and continues to enlarge its range of services locally, regionally and nationally. The 1990 opening of its sister organization, ***Centro de Estudio Ambiental (CEA)*** in San Jose, Costa Rica, expanded the Center's mission internationally.

WHAT IS TREE AMIGOS?

Tree Amigos is a special cross-cultural program. Using trees as our common bond, **Tree Amigos** brings the peoples of the Americas together in unique partnerships to preserve and protect our shared global environment.

Today, we are faced with many complex environmental problems. In an effort to help solve the problems we ask: "What can I do? How can I make a difference?" Everyone can make a difference by planting a tree. From that action we learn the steps we can take together to preserve and protect our shared global resources. **Tree Amigos** is a very tangible program which embodies the philosophy that individuals, acting together, can make a difference.

TREE AMIGOS

GOALS OF TREE AMIGOS:

- To use trees as a common theme to teach global environmental concepts, responsibility, and respect
- To develop global partnerships in the preservation and protection of our shared global environment
- To assist in the reforestation of the Americas
- To increase cross-cultural communication and understanding

COMPONENTS OF TREE AMIGOS:

SCHOOL PROGRAMS

Tree Amigos involves Latin American and United States schools in environmental programs adapted to meet individual school and/or classroom needs. This may include tree planting, materials exchange, classroom interchange, curriculum integration and translation, teacher training, and other services for educators and their students.

COMMUNITY PROGRAMS

Tree Amigos works with community organizations to incorporate or integrate tree planting and environmental education programs. Programs are adapted to each organization's needs. For example, Girl Scouts may earn a "Tree Badge;" Audubon Earth Day projects can include **Tree Amigos** efforts; media promotion/public service campaigns may include the **Tree Amigos** theme.

PROFESSIONAL TALENT EXCHANGE

Tree Amigos recruits volunteers with special talents who are willing to share their expertise to help solve specific problems in key areas. Volunteers include educators, engineers, media specialists and others.

TROPICAL FOREST FUND

Tree Amigos continues the Center's efforts to raise funds for preservation and protection of the tropical forests through its Tropical Forest Fund. Various programs and activities allow individuals and corporations to "adopt" acres of tropical forest for a specified donation. Donors receive a certificate recognizing their gift for land acquisition, education, research or other designated projects in Latin America.

CORPORATE PARTNERSHIPS

Tree Amigos encourages corporations to become partners in all phases of our efforts. Under the **Tree Amigos** banner we help corporations enhance their environmental profile and community involvement. The Center is also a partner in the American Forestry Association's "Global Releaf" Program and represents this program in Central America.

WHAT IS THE CENTER'S TROPICAL FOREST FUND?

- The Center's Tropical Forest Fund was established as part of our **Tree Amigos** program to help promote partnerships to effectively protect the remaining tropical forests and support reforestation and education projects in Latin America. All donations to the fund are charitable gifts and are tax-deductible as allowed by law.

- The Fund supports projects which attempt to develop sustainable approaches and well-reasoned policies for Tropical Forest preservation and protection.

- Areas supported by the fund include:

    - Land Acquisition and Protection
    - Education and Public Information
    - Research and Technology Transfer
    - Reforestation Projects

When we invest in Costa Rican conservation efforts, our chance for success is maximized because of this country's:

- Progressive leadership & governmental stability

- Exemplary educational system

- Strong tradition of scientific research
- Welcoming attitude toward international partnerships
- High priority for conservation efforts, with nearly 27% of its land placed into national parks and preserves

The Center is involved with other projects in Panama, Ecuador and Mexico working closely with NGOs and research stations. The Centro de Estudio Ambiental is forging new relationships with environmental groups throughout Latin America.

FOR MORE INFORMATION, CONTACT:

CENTER FOR ENVIRONMENTAL STUDY
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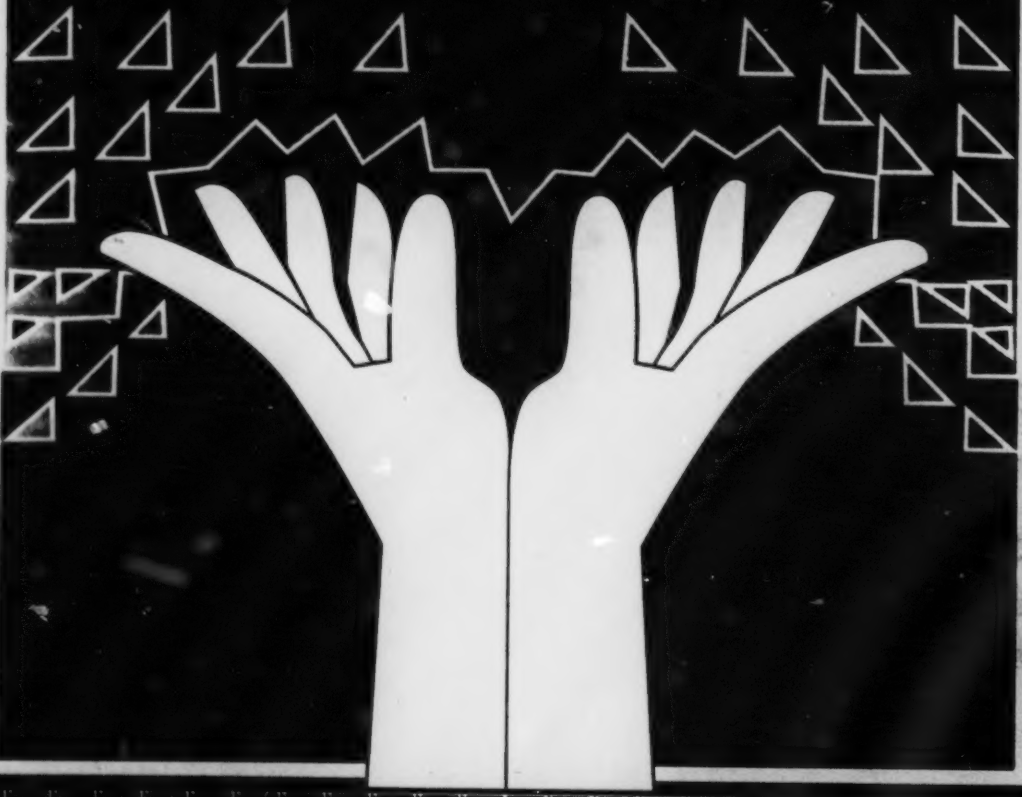
FAX (616) 771-4005

Generous support for this program has been provided by the Wege Foundation, Grand Rapids Foundation, Steelcase Foundation and many other **Tree Amigos** partners.

TREE
AMIGOS

TREE AMIGOS
ACTION
PROJECTS



TREE AMIGOS ACTION PROJECTS

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Tree Amigos have accomplished all kinds of great things throughout the Americas. Here are some ideas, strategies, and success stories that will help you design the perfect project for your class, school, community and planet!

Send us your good ideas on the Tree Amigos Project Report form found at the end of this Section of this notebook. You will also find Tree Amigos forms, "Adopt an Acre" materials, logo sheets, and other forms to duplicate.

TREE AMIGOS ACTIVITY

ACTION PROJECT: Tree Amigos Vocabulary/Vocabulario

OBJECTIVE: To introduce bilingual vocabulary that illustrate the integration of languages and culture.

AGES: Second-Grade through Eighth-Grade

DESCRIPTION: A variety of classroom activities have used the Tree Amigo bi-lingual vocabulary including:

BILINGUAL BULLETIN BOARD: Have students find or draw pictures which represent the bi-lingual Tree Amigo words and decorate a bulletin board with the pictures and words. With the help of a Spanish/English dictionary students can draw their own Tree Amigos picture and find new words.

WORDS WITH SIMILAR ROOTS: Copy the vocabulary list (reverse), then have students guess the missing words that have similar roots or are commonly used in English. Have students list other Spanish words that have become part of common English usage.

WORD SEARCH: Providing students with a bi-lingual dictionary have them look up common words then illustrate with photos or drawings.

TREE AMIGOS

VOCABULARY/VOCABULARIO

TREE.........ARBOL

*FRIEND.........*____________

____________*..........TIERRA*

LEAF........HOJA

ROOT........RAIZ

WATER........AGUA

____________*........AIRE*

____________*........CONSERVACION*

HOME........HABITACION

____________*.....CONTAMINACION*

*YES........*_________

_________*........NO*

I LIKE........ME GUSTA

WORLD........MUNDO

____________*........MAPA*

*THANK YOU........*____________

TREE AMIGOS

VOCABULARY/VOCABULARIO

TREE.....ARBOL

FRIENDS.....AMIGOS

EARTH.....TIERRA

LEAF.....HOJA

ROOT.....RAIZ

WATER.....AGUA

AIR.....AIRE

ANIMAL.....ANIMAL

CONSERVATION.....CONSERVACION

HOME.....HABITAT

POLLUTION.....CONTAMINACION

YES.....SI

NO.....NO

I LIKE.....ME GUSTA

WORLD.....MUNDO

MAP.....MAPA

THANK YOU.....GRACIAS

A SAMPLING OF TREE AMIGOS PROJECTS

TREE AMIGOS CLASSROOM

Tree Amigos teacher Mary Ann Challa has developed a **Tree Amigos** classroom for her first-grade students at Stocking Elementary School in Grand Rapids. Students have decorated walls like a tropical forest and a science station has been set up to help the children learn forest concepts. Recently, Costa Rican **Tree Amigos** coordinator Luis Sanchez visited the classroom to bring Latin America to life. Additionally, the children have been involved in tree planting in their school yard.

TREE AMIGOS URBAN REFORESTATION

High school students at Napoleon Quesada High School in Costa Rica are creating a teaching park in an abandoned lot next to their school. Funded by a $23,500 grant from the Wege Foundation, these energetic **Tree Amigos** have been working with local architects, foresters, businesses and other community partners to design and plan this urban green space. This project was inspired by a 1989 tree planting campaign.

TREES FOR TREE AMIGOS

Tree Amigos at a psychiatric hospital in San Jose, Costa Rica plant and care for endangered tropical trees for use in area reforestation projects.

RURAL SCHOOLS PARTNERSHIPS

Rural and one-room schools in the Guanacaste region of Costa Rica are being provided with new educational materials and "recycled" U.S. classroom equipment through donations secured by the **Tree Amigos** program.

TREE AMIGOS IN ACTION

Tree Amigos travel/study programs are being developed to recruit teachers, students and other conservation-minded travelers to participate in teachers beach clean-up and tree-planting projects in Latin America.

TREE AMIGOS PARTNERSHIPS

Costa Rican service clubs, classrooms, and other community groups are participating in seed-bank and tree planting programs to preserve endangered tropical plants.

PENNIES FOR PYTHONS & PARROTS

More than 20,000 pennies to preserve and protect the Children's Rainforest in Monteverde have been collected by elementary and junior high students at St. Andrew's School, part of the Grand Rapids' Catholic schools system.

SAVE THE EARTH AND HAVE FUN, TOO

Fiesta Tropical, a night of Latin dancing at a Grand Rapids restaurant and night club, helped raise more than $5,000 to purchase acreage in the Costa Rican National Parks system. Corporate sponsors helped make this event possible.

GOOD PROJECT IDEAS

Here's a quick list of good ideas for your ***Tree Amigos*** *project. Try one! Many of these projects have been shared with us by teachers and students who have told us they've had fun and learned a lot through their* ***Tree Amigos*** *efforts.*

- Host a community tree planting day.
- Teach a tree lesson, integrating trees into your curriculum.
- Collect recyclables and donate proceeds to save an acre of rainforest.
- Design and plant a "green area" in your community.
- Adopt a tree and learn how to plant new trees and care for older trees.
- Write your representative or senator about your concern for deforestation and global environmental problems.
- Learn how to recycle household materials such as paper, plastic, metal, and glass.
- Plan a cross-cultural **Tree Amigos** Party with tropical foods and music.
- Host an interdisciplinary tree teach-in, including science, art, music, ethics, environment, economics.
- Invite your local forester to talk to your group.
- Explore "Tree Careers."
- Make a display of various products provided to us by trees.
- Read a "Jungle Book" (See the **Tree Amigos** book list provided in the "Resources" section of the **Tree Amigos** Notebook).
- Watch and discuss the "Emerald Forest" video.
- Give an acre of tropical forest for a gift (Look for the **Tree Amigos**/Tropical Forest Fund Certificate in the **Tree Amigos** section of the **Tree Amigos** Notebook).

- Design **Tree Amigos** greeting cards using recycled materials and send to friends.
- Use "environmentally safe/friendly products."
- Encourage use of recycled materials in your school.
- Share tree information in your school's newsletter.
- Begin an office paper recycling program.
- Prepare a **Tree Amigos** skit or play to perform for your school or parents.
- Report "sick trees" to your community forester.
- Plant a tree every "Arbor Day" for a lifetime!
- Plant a tree with a younger child (mentored by an adult or older child).
- Give a tree to someone to celebrate a special occasion such as a birthday, anniversary, etc.
- Host a concert for "trees" with proceeds to benefit a reforestation project.
- Host a **Tree Amigos** walk-a-thon, run-a-thon, bike-a-thon or read-a-thon.
- Treat yourself and a friend to a **Tree Amigos** t-shirt.
- Sell "Rainforest Crunch" as a class project.
- Share your **Tree Amigos** good ideas with other teachers.
- Make "tree" cookies and sell them at a bake sale.
- Turn your school cafeteria into a jungle with art projects sponsored by each class.
- Host a "Tree Forum" to discuss important issues such as: global warming, ozone, urban reforestation, tropical forests, deforestation, economics and ecology, etc.
- Turn your classroom into a forest laboratory with experiments that can be shared with other classrooms.

MAKING YOUR TREE AMIGOS PROJECT A SUCCESS!

Follow these simple but important steps as you design and implement your Tree Amigos projects. Remember: the more you put into planning, attention to details and follow-through, the more you'll get back from your project.

STEP 1.
List the desired result(s) of your project.

STEP 2.
Describe your project.

STEP 3.
Detail the resources/authorizations necessary to complete the project.

STEP 4.
Match necessary resources/authorizations with people/organizations which can provide you with these resources/authorizations.

STEP 5.
Outline the steps necessary to carry-out the project. Identify alternatives where necessary.

STEP 6.
Assign responsibility for each of the steps (Identify "workers" and "managers").

STEP 7.
Develop project timelines...when tasks must be completed. Include dates when check-ups will occur to make sure things are going as planned.

(continued)

STEP 8.
Help keep participants enthusiastic and "on track" as they make progress toward completing their assigned tasks.

STEP 9.
Enjoy the project!

STEP 10.
Evaluate your project and make recommendations for changes for your next one.

STEP 11.
*Write **Tree Amigos** about your project so we can share your good ideas with other **Tree Amigos** groups. Use the convenient **Tree Amigos** Project Report form found in this Section.*

AND EVERY STEP OF THE WAY, SAY "THANK YOU!"

TREE AMIGOS ACTIVITY

ACTION PROJECT: Rainforest Readers

OBJECTIVE: Provides an opportunity for students to improve language arts skills while raising funds to "adopt" acres of tropical forests.

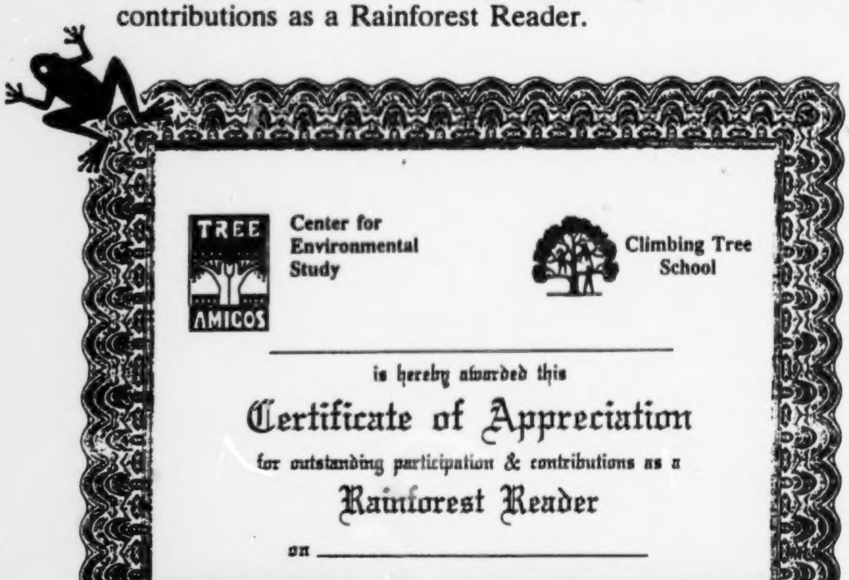
AGES: Pre-school through Fifth-grade Students

DESCRIPTION: This exciting activity was designed by Climbing Tree School, one of our first **Tree Amigos** schools in Grand Rapids, Michigan. Climbing Tree "Rainforest Readers" collected pledges for books they read or had read to them at home and at school during March ("Reading Month"). Children were encouraged to read books related to nature or the environment. Teachers planned special activities and projects about the rainforests during this time. One class presented a "Rainforest Revue" for their parents and other students.

In addition, Climbing Tree arranged to have an "in-store" book fair at Pooh's Corner (a local bookseller). Parents received a 10% discount on books purchased during one week in March. Pooh's Corner sent Climbing Tree 10% of their sales from the book fair and this money was added to the children's pledge money.

A letter was sent home with children to explain the read-a-thon to parents. Pledge sheets and a bibliography from Pooh's Corner were also included. Teachers also included books read in the classroom and sent home the list of titles which was added to children's pledge sheets.

Each student was awarded a specially-designed certificate for their participation and contributions as a Rainforest Reader.



TREE AMIGOS

Center for
Environmental
Study

Climbing Tree
School

____

is hereby awarded this

Certificate of Appreciation

for outstanding participation & contributions as a

Rainforest Reader

on ______________________________

TREE AMIGOS ACTIVITY

ACTION PROJECT: *Environmental Action Council*

OBJECTIVE: *Develop students' problem-solving and team-building skills; provide community organizing experiences; improve research skills; and, develop initiative and an understanding of what it takes to get things done.*

AGES: *Elementary*

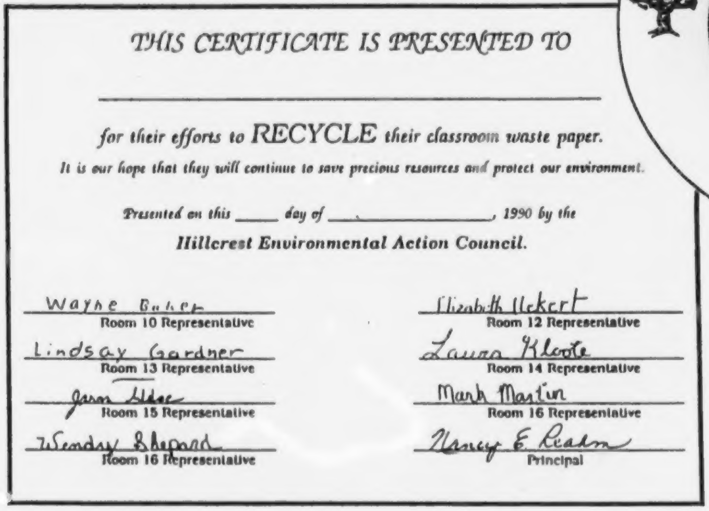
DESCRIPTION: At Hillcrest Elementary School in Grand Rapids, Michigan, seven third through sixth grade students formed a committee called the Hillcrest Environmental Action Council. During regularly scheduled meetings and through self-assigned research, the students identified and developed solutions for environmental problems which they noticed in their school environment. Among their efforts, they initiated a school recycling program and have been working to reduce the use of styrofoam in their lunch program.

In the process of solving the school's problems, the students took the initiative to educate their teachers, peers, parents and family and had interaction with members of the Grand Rapids Board of Education as well as Grand Rapids Public Schools administrators in order to help find solutions.

In addition to their local actions, they also took responsibility for helping to protect the global environment. They hosted a recycled toy sale to help raise funds to adopt acres of tropical forest through the "Tree Amigos" Tropical Forest Fund.

For more information, contact:
Hillcrest Elementary School
Nancy Reahm, Principal
616/771-2610

HILLCREST ENVIRONMENTAL ACTION COUNCIL



THIS CERTIFICATE IS PRESENTED TO

____

for their efforts to RECYCLE *their classroom waste paper.*

It is our hope that they will continue to save precious resources and protect our environment.

Presented on this ____ day of ________________, 1990 by the

Hillcrest Environmental Action Council.

Wayne Baker Room 10 Representative	Elizabeth Uckert Room 12 Representative
Lindsay Gardner Room 13 Representative	Laura Kloote Room 14 Representative
Jason Aldoe Room 15 Representative	Mark Martin Room 16 Representative
Wendsy Shepard Room 16 Representative	Nancy E. Reahm Principal

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ACTION PROJECT: Earth Friendship Bracelet

OBJECTIVES: Develops organizing and entrepreneurial skills; fosters creativity

AGES: Upper Elementary through High School

*DESCRIPTION: Make Earth Friendship Bracelets and sell them as a fundraiser to support your **Tree Amigos** projects. The Earth Friendship statement which follows can be provided with each bracelet or you can have a classroom presentation/assembly where the statement is read. You may also want your students to practice their language arts skills to develop their own comments on their relationship to our global world.*

MATERIALS:
- *Blue, green, yellow, and brown floss (from any fabric store)*
- *Masking tape*
- *Scissors*

EARTH FRIENDSHIP BRACELET INSTRUCTIONS:

To begin, you have four rolls of colored floss: brown, yellow, blue, and green. Pull the floss out until it is about arms length and then cut it. Take the four strings and tie them together, leaving about 2 inches of fringe at the top. Tape the fringe to a table. Then, take the **BROWN** strand in your left hand. Place your right index finger in the middle of the **BROWN** string and place the string below your finger over the other three. This should look like a number four. Then, pull the end of the **BROWN** string under the three strings and pull firmly upward. Repeat this again with the **BROWN** string. Then take the **YELLOW** string and do the same process again twice. Do this with the **BLUE**, then the **GREEN**, then the **BROWN** again and so on, keeping the color order: **BROWN, YELLOW, BLUE, GREEN**. Continue until the bracelet looks about your wrist size. Let a friend tie it with an ordinary knot around your wrist.

"FRIENDS ON EARTH, FRIENDS WITH EARTH"

By wearing this earth friendship bracelet, you pledge fellowship to the people of the world and have taken the hand of Mother Earth as well. As it is tied about your wrist, this bracelet secures your commitment to cherishing the world around you.

Let it be a constant reminder of your continued compassion and let it inspire you to reach out toward further global understanding. As you intertwine the threads, you symbolize the cooperation of every facet of nature. The blue represents our sky and our water. The green symbolizes trees and other plant life. The brown represents the soil and the golden thread symbolizes the energy of the sun. Every aspect of our natural world fits together, to work together.

Now you have given yourself to preserve all aspects of our Earth's beauty. Encourage your family to recycle and help save our emerald trees. If it is a warm pleasant day, walk instead of drive and aid in keeping our precious air clean. Don't litter your empty bags and wrappers on the ground. Help beautify your neighborhood and keep our Earth healthy.

There are many small yet significant things you can do to allow nature's well-being to continue into the future. And perhaps through our friendship we can make a difference. Preserving our planet by collective effort is the pledge you have made. Save Mother Earth for your eyes, your heart, and for those of the generations to come!

Wear this bracelet as a reminder....

- Sarah Reagan
Tree Amigo
City High School, Class of 1991
Grand Rapids, Michigan

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TREE AMIGOS ACTIVITY

ACTION PROJECT: Aluminum Can Collection

OBJECTIVE: *Provides an opportunity for students to learn recycling concepts and tropical forest ecology while raising funds to "adopt" acres of tropical forests.*

AGES: *Pre-school through High school*

MATERIALS: *Collection Boxes; Promotional Flyers (see the following two pages)*

DESCRIPTION: This exciting activity has been conducted in many Tree Amigos classrooms in West Michigan and throughout the United States. Children were encouraged to bring in aluminum cans (and glass and plastic bottles in Michigan). The Michigan Bottle Law passed in the early 1970's, establishing a 10 cent deposit on most effervescent beverage cans and bottles.

Can collection flyers were posted in various areas in the school and a collection center was set up in the school. Students, teachers, staff and administration quickly began filling it. The aluminum cans and glass and plastic bottles were returned to local supermarkets and the deposit money was collected and held by the teacher.

When the can drive was finished the money was donated to The Tropical Forest Fund of the Center for Environmental Study. The donation was designated to go to reforestation projects in Latin America and/or to land acquisition to help preserve and protect acres of tropical forest in Costa Rica.

Over $150,000 to date have been raised through the creative action projects developed by students and educators. Due to the overwhelming success of projects like the can collection activity, students have raised enough funds to enable the Center for Environmental Study to purchase $20,000 worth of acreage in the remote Osa Peninsula of Costa Rica. This land was acquired in June 1992 and will be forever designated The Children's Tree Amigos Forest.

On the following pages you will find two copy-ready posters that can be distributed throughout your school. Help protect the remaining Costa Rican tropical forests and reforest newly acquired park and preserve lands.

TREE AMIGOS

EXTRA! EXTRA!

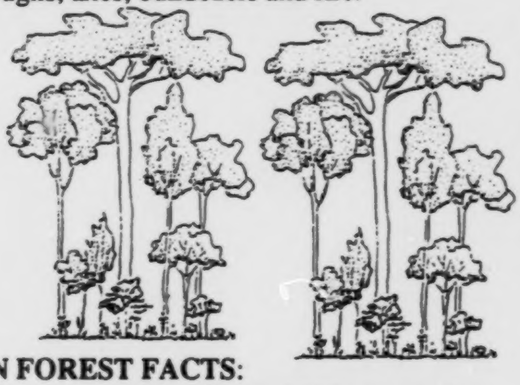
SAVE THE RAIN FORESTS

THIS IS YOUR CHANCE TO HELP! PLEASE BRING YOUR EMPTY CANS TO THE COLLECTION CENTER!

Our school has a chance to help the Earth. The Center for Environmental Study has a program called the **Tree Amigos**. We can raise money for the rain forest by recycling aluminum cans. ***For every $25 we raise, we can help save one acre of rain forest from being destroyed.***

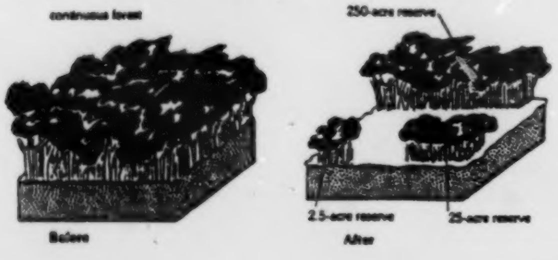
Rain forests are being cut down all over the world. This process is called deforestation. Deforestation affects animals, plants, native peoples, the planet as a whole, and YOU!

Each year, millions of acres of rainforest are lost to ploughs, axes, bulldozers and fire.



RAIN FOREST FACTS:
Rain forests are cut at a rate of 100 acres each minute. An area the size of Pennsylvania is destroyed each year.

More than **50%** of the world's original rain forest cover has **already** been destroyed.



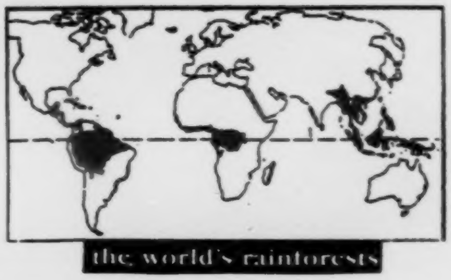
Rain forests cover only 7% of the globe but they are home to 50-80% of the world's plant and animal species.

A full quarter of all prescription drugs are derived from rain forest plants.

Native rain forest peoples around the globe are being forced from their lands, and they are dying from disease and violence.

Cutting down the trees speeds up global warming because trees breathe in CO^2 and then breathe out oxygen for us. When the rain forest is destroyed, the trees can no longer take extra carbon out of the air.

CLEAN UP THE LITTER OUTSIDE. WHEN YOU FIND RETURNABLE CANS, BRING THEM TO THE COLLECTION CENTER AND HELP US SAVE THE REMAINING RAINFORESTS.



the world's rainforests

HELP US SAVE THE RAIN FOREST!

BRING IN EMPTY ALUMINUM CANS.

ONLY 250 CANS WILL PROTECT AN ACRE OF RAIN FOREST!

TREE AMIGOS

ACTION PROJECT: *Foods from the Tropical Forests*

OBJECTIVE: *Learning about tropical forest food products while expressing their creativity through coloring.*

AGES: *Pre-school through Fourth Grade*

MATERIALS: *Copies of five copy-ready botanical artwork that follow*
Colored pencils, Crayons, Markers

DESCRIPTION: *This activity provides an opportunity for students to learn about some common products that grow in tropical forest areas of Latin America, while expressing their creativity through coloring.*

DIRECTIONS: Prepare students for this activity by reviewing their prior knowledge in regard to the different foods and products that are indigenous to tropical forests. (You may find additional product information in the "Jungle in the Pantry" activity created by Ranger Rick's Nature Scope located in the People and Resources Section of the **Tree Amigos** Resource Book).

You will find complete botanical descriptions of the five tropical plants depicted in the artwork. The descriptions were compiled by Dr. Rick Sullivan of the Center for Environmental Study.

After discussion of the products and foods found in tropical forests and the benefits to everyone in preservation rather than deforestation of tropical forests, distribute the five copy-ready botanical drawings to students. You may also discuss the English, taxonomic and Spanish description of each botanical planted depicted in the drawings.

These beautiful drawings were provided to the Center for Environmental Study by Ms. Barbara Wesholski, PO Box 114, Comstock Park, Michigan, 49321. Barb is a recent graduate of the Arts Division of Grand Rapids Community College in Grand Rapids, Michigan.

TROPICAL FOOD PLANTS

Cacao (*Theobroma cacao*); chocolate

When the Spanish first reached the New World, they found the inhabitants drinking a concoction made from chocolate and flavored with chilis. The explorers tried the drink and pronounced it awful. Eventually, however, chocolate made its way to Europe, and when the Europeans finished adapting the pungent pod to their own tastes -- adding vanilla (also from the New World) and sugar, for instance -- it had earned its Latin name: *Theobroma,* or "food of the gods." Cacao originated on the eastern slopes of the Andes, but today it is grown throughout the tropics. It is a major export crop and has become one of the most familiar and favorite of all foods worldwide.

The cacao is a small tree that needs shade and much rainfall. Typically, it reaches no more than 20 to 30 feet in height; the flowers -- and therefore the fruit -- grow directly from the trunk of the tree.

Coffee (*Coffea arabica*); cafe

Despite its name (*arabica*), coffee originated in Ethiopia. It was introduced to Europe in the seventeenth century, when it immediately became extremely popular. Coffee houses sprang up all over Europe; the famous Lloyd's of London insurance company began as a loose partnership of wealthy businessmen who met in a coffee shop. Although coffee can be grown in a number of climates and elevations, the best coffee comes from middle elevations in areas with a strong seasonal dry period, good soils, and good drainage. The highlands of Colombia and Costa Rica produce some of the world's finest coffee.

The coffee tree is actually a shrub that typically grows no more than 15 feet high. The leaves are a shiny, dark green. The red fruits contain two seeds, which are removed and dried before they are exported or roasted. Much of the work of coffee growing and harvesting is still done by hand.

Papaya (*Carica papaya*)

The papaya is native to Mexico and Costa Rica, but it has been domesticated for so long that it no longer occurs in the wild. The fresh papaya fruit, which may weigh as much as 9 kg, is eaten throughout Latin America; it is also used in making soft drinks, sweets, jams, ice creams and other delicacies. In addition, the papaya is the source of papain, a valuable commodity to industry. Papain is used in meat tenderizers, chewing gum, cosmetics, and many other applications. Papain is obtained from the immature papaya fruits.

The papaya is a small tree (7-30 feet high, typically) that grows very fast and lives only for a short time. It grows well at mid to low elevations in good soil. The flesh of the fruit is yellow to reddish orange.

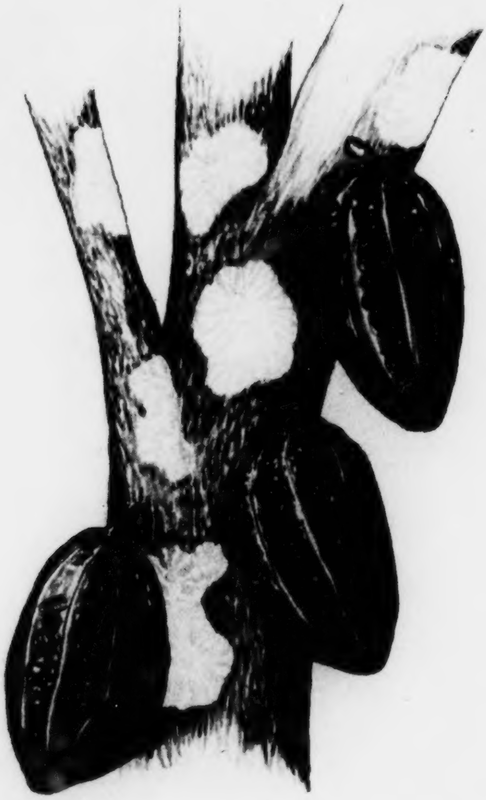
Banana, (*Musa* spp.); platano, banano, guineo

The diverse group of banana plants that we know today (more than 30 varieties) has resulted from the hybridization of two Asian plants. The first bananas grown in the Americas were planted in Hispaniola in 1516. Today, the banana is the most important plant, in economic and social terms, grown in Central and South America.

Bananas are widely grown in back yards and gardens throughout Latin America, as well as in large commercial plantations. The different varieties range from small to large, bland to sweet, and red to yellow, and each is distinct from the others. Commercial bananas in Latin America come primarily from two varieties.

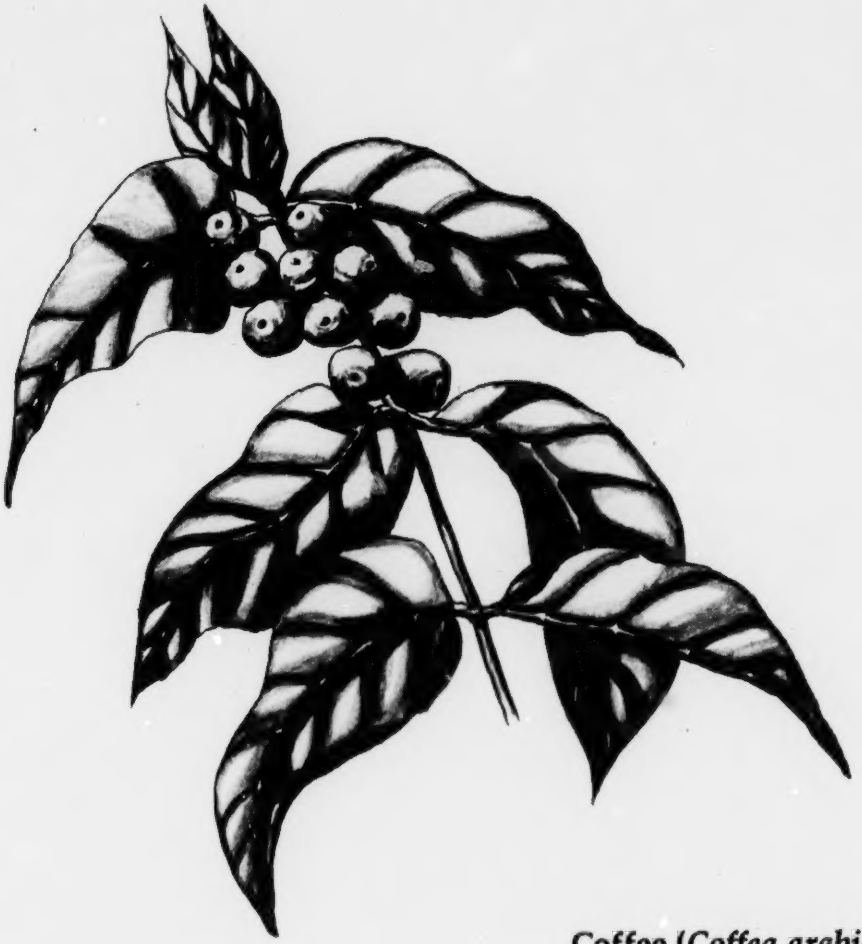
Vanilla (*Vanilla planifolia*); vainilla

The vanilla flavoring so familiar to us all comes from the pods of a climbing orchid plant. There are two species of vanilla, one native to the Americas and the other from Tahiti. Most of the world's supply comes from the Tahitian variety, but in Latin America vanilla is still grown widely, and the New World variety is considered to have a better flavor. The vanilla fruits are harvested when still unripe; at that time they have no aroma. The familiar smell is the result of a curing process. Artificial vanilla, a cheap substitute used in many food products, is a by-product of the wood industry.



Cacao (*Theobroma cacao*); chocolate

Barbara Wesholski
PO Box 114
Comstock Park, MI 49321



Coffee (*Coffea arabica*); cafe

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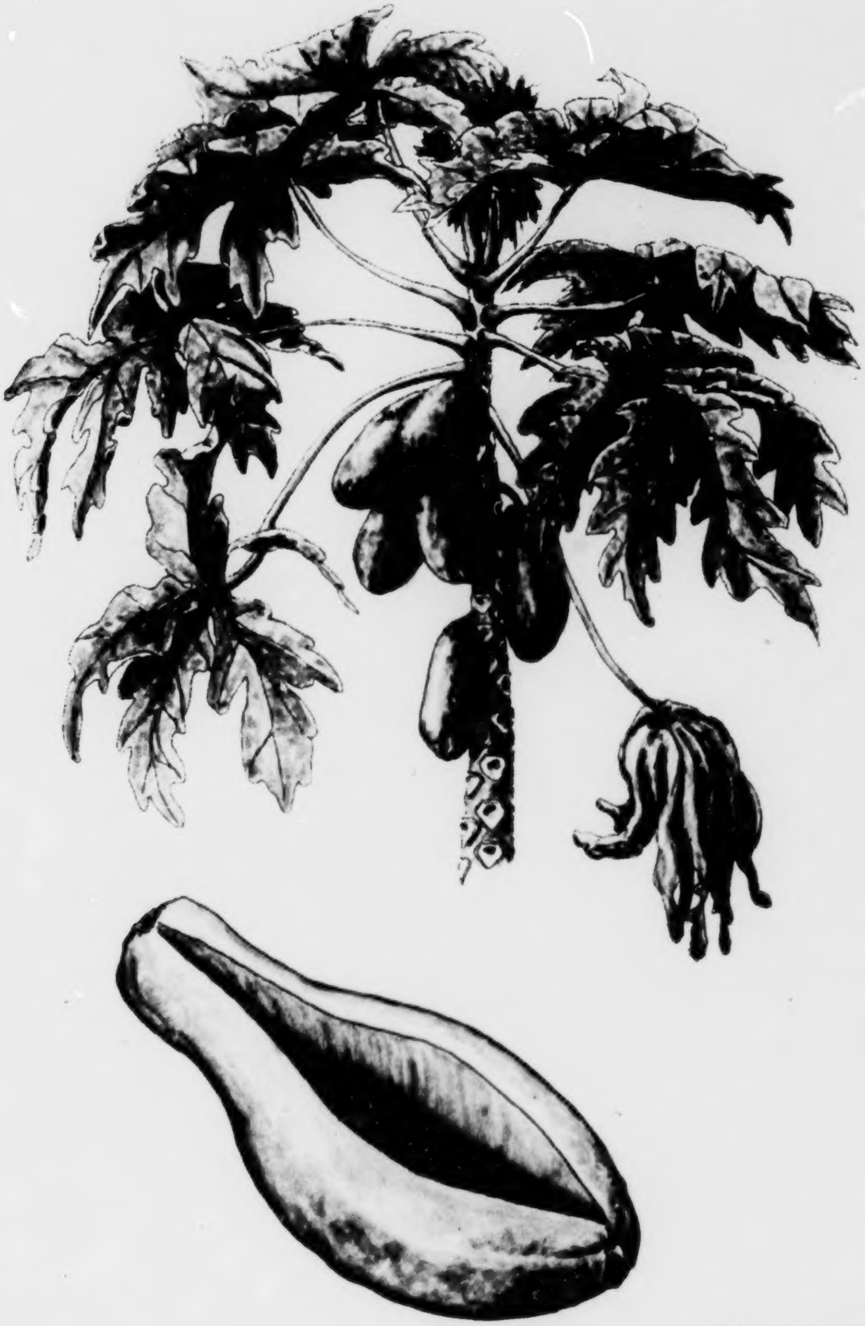
Comstock Park, MI 49321



Papaya (*Carica papaya*)

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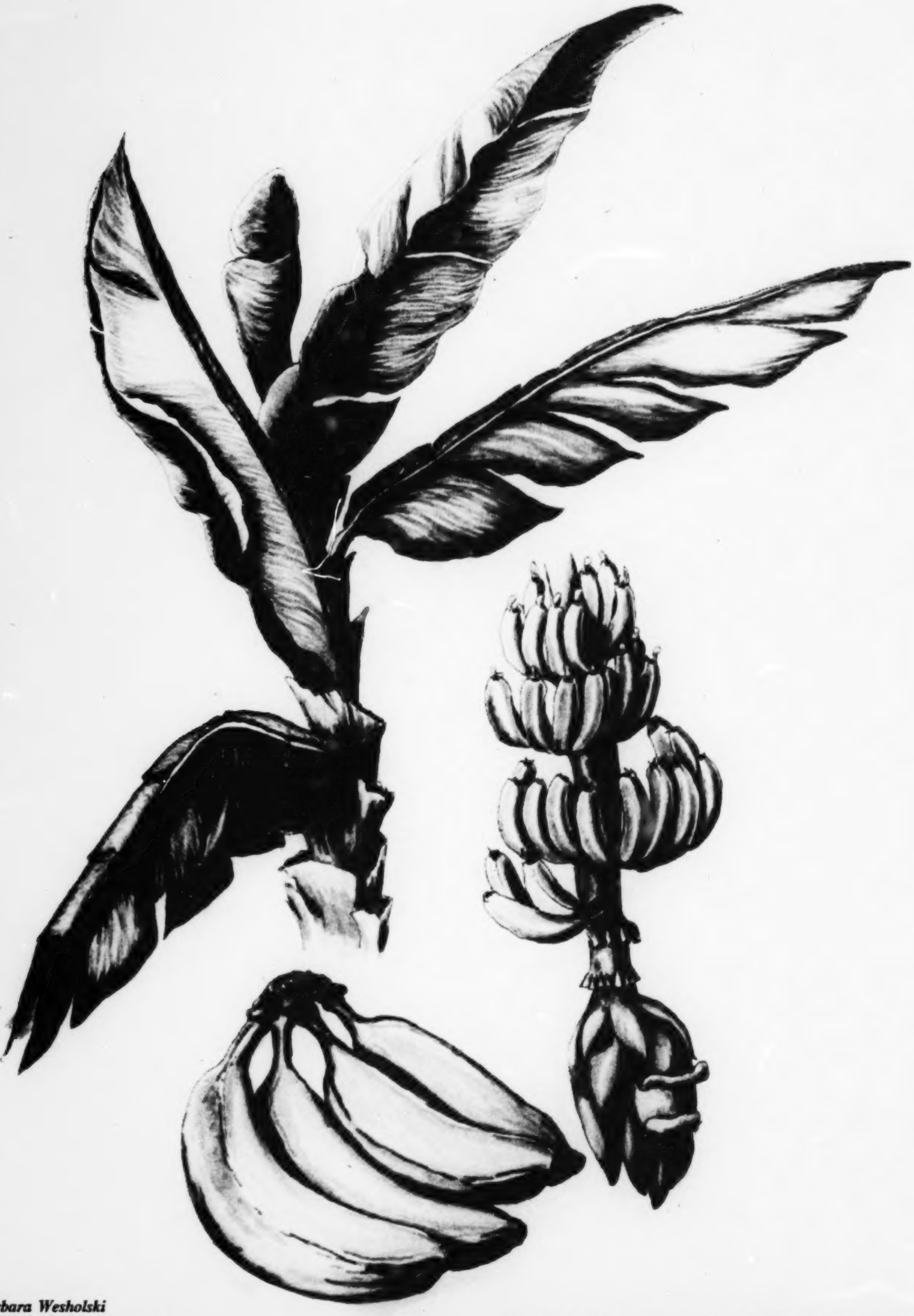

Barbara Wesholski
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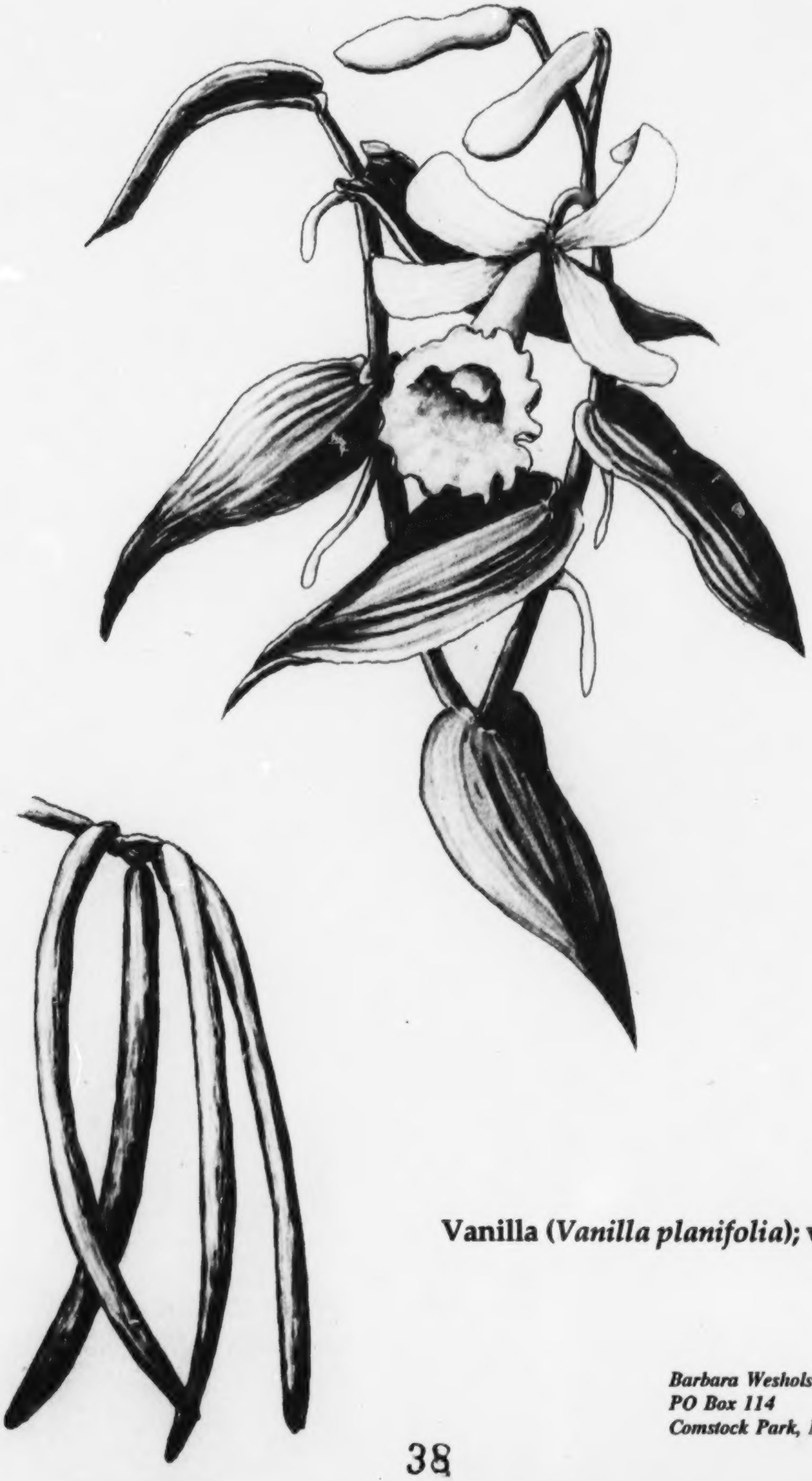
Comstock Park, MI 49321

Banana, (*Musa* spp.); platano, banano, guineo



Vanilla (*Vanilla planifolia*); vainilla

Barbara Wesholski
PO Box 114
Comstock Park, MI 49321

Exhibits

Many simple exhibits can be created to give examples of natural and human recycling. Here are a few ideas:

Cycles — posters or bulletin board displays showing natural cycles like water, nutrient, CO2/O2, and rock cycle or human recycling showing paper, aluminum, plastic, etc.

Nature's Recyclers — posters or bulletin board display showing nature's recyclers and the roles that they play.

Nature's Litter — Make a poster or display that shows nature's litter on the forest floor and the various stages of its decomposition. This could be done as part of a soil profile.

Packaging — gather examples of the following packages for a "hands on" table:

Natural — acorn, cones, milkweed pods, egg shell, orange peel, coconut

Old — returnable bottle, pottery, birch bark container, paper egg carton, basket

New — plastic bags and bottles, aluminum can, bimetal can, "blister pack", polystyrene egg carton

Deadly Litter — create a display or collage using plastic 6-pack holders, balloons, fishing line, aluminum flip or tab tops, polystyrene particles, nylon netting, broken glass, open cans and appropriate magazine pictures or photographs showing their deadly impact on wildlife.

Renewable/Nonrenewable Resources — collect and display the following examples:
cereal box—paper—pulp—wood—tree—soil—earth
pop bottle—glass—sand—rock—earth
Al can—sheet Al—Al ingot—AlO2—bauxite—earth
plastic bottle—melted plastic—oil—earth
apple—tree—soil—earth

Natural Reuse — collect and display examples of natural objects being reused in nature such as: grass, leaves, mud and hair for nesting material, shells for invertebrate homes, etc. Show human reuses too — reed chairs, grass mats, etc.

Composting — set up a compost bin (or examples of several types of bins) and use it! Create a display comparing leaf litter decomposition with composting.

Community Recycling — Find out what is recyclable in your community and set up a display showing recyclable items and their preparation for recycling.

Your Daily Waste — Assemble examples of an individual's daily and weekly accumulation of trash. Use photos for monthly and yearly trash.

Why Waste? — Set up a display using pictures, products, and narrative information to explain the magnitude of the resources that we use and dispose of each year.

Hazardous Household Products — Set up a display of these products and environmentally safe alternatives.

Environmentally Safe Shopping — Set up a display or pictures showing shopping alternatives to our disposable/throw-away society (ie buying in bulk, buying returnable bottles, etc.).

Resourceful vs Wasteful Picnic — Set up a display that compares a picnic using a picnic basket with its reusable plates, cups, utensils, napkins and food containers with a picnic using all disposable plates, cups, utensils, napkins and food containers. Show the amount of trash that each one generates.

"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

WE WANT TO BE TREE AMIGOS!

TREE
AMIGOS

Center for Environmental Study • Centro de Estudio Ambiental

I would like my classroom or group to join Tree Amigos to help preserve and protect the world's forests and the global environment they help support.

_____ Please add me to your **Tree Amigos** mailing list so we can learn more about the **Tree Amigos** program.

_____ We would like to become a **Tree Amigos** partner with the following donation:

_____ $5.00 to 25.00 to plant trees with school children in Costa Rica

_____ $25.00 to help preserve an acre of tropical forest

_____ We would like to order **Tree Amigos** t-shirts or materials (enclose order form with check or money order payable to "**Tree Amigos.**") Please send me:

______ TREE AMIGOS tee-shirt/s at $10.00 each
Sizes: ____6/8 ____ 10/12 ____14/16 ____ S ____ M ____ L ____ XL

_____ We would like to order _____ **Tree Amigos** cloth bags at $8.00 each.

Name ______________________________________
School or Group ______________________________
Address ____________________________________
City ____________________ State _____ Zip _______
Country _______________
Phone _______________
Age or Grade ____________

Please return to:

CENTER FOR ENVIRONMENTAL STUDY • TREE AMIGOS PROJECT
143 Bostwick NE • Grand Rapids, MI 49503 • (616) 771-3935 • FAX (616) 771-4005

TREE AMIGOS PROJECT REPORT

Center for Environmental Study • Centro de Estudio Ambiental

TREE
AMIGOS

We would like to recognize successful Tree Amigos activities/projects and share your "good ideas" with other Tree Amigos.

Description of your Project:

Materials Developed for Project (Please attach sample copies):

Description of Target Audience:

Numbers of People Reached: ________________
Project Dates: ____
Type of Documentation Available: *Photos* ____
Slides ____
Video ____
Press Clippings ____

Organization: ____
Contact Person: ______________________________________
Address: ____
____
____
Phone: __________________________
Fax: ____________________________

Please Return to:

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ADOPT AN ACRE OF TROPICAL FOREST!

Center for Environmental Study • Centro de Estudio Ambiental

TREE AMIGOS

The Center for Environmental Study is pleased to be a United States contact for tropical forest and tropical ecology projects in Latin America. Working with groups in Costa Rica, Ecuador, Nicaragua, Panama, and Mexico, the Center promotes research communication, environmental education and international exchange programs in Latin America.

Through donations of talent and financial resources, we can help protect and preserve the world's tropical forests and the millions of plant and animal species they contain.

> **For each $25 donation,** you can adopt approximately an acre of tropical forest for preservation or protection.
>
> **For each $50 donation,** you can provide environmental education materials to a rural school.
>
> **For each $100 donation,** you can help **reforest** an acre.

JOIN US...You can help! A special certificate will be sent to recognize your donation.

YES, I WANT TO BE ACTIVE IN THE CENTER'S INTERNATIONAL TROPICAL FORESTS PROJECT.

Name ____________________ Phone ______________

Address ______________________________

____
City State Zip Country

( ) I would like to make a tax-deductible donation of $______ to the Center's **Tropical Forest Fund** in the following area:

( ) **Land Acquisition/Protection** ( ) **Education** ( ) **Reforestation**
( ) **Research** ( ) **Unrestricted**

( ) My donation is a gift to honor: **Name** ______________________
Send certificate and letter to: **Address** ______________________
____

Please Return to:

CENTER FOR ENVIRONMENTAL STUDY • TREE AMIGOS PROJECT
143 Bostwick NE • Grand Rapids, MI 49503 • (616) 771-3935 • FAX (616) 771-4005

THE TROPICAL FOREST FUND

- The Center's Tropical Forest Fund was established as part of our **Tree Amigos** program to help promote partnerships to effectively protect the remaining tropical forests and support reforestation and education projects in Latin America. As a program of the Center, donations to the fund are tax-deductible.

- The Fund supports projects which attempt to develop sustainable approaches and well-reasoned policies for Tropical Forest preservation and protection.

- Areas supported by the fund include:

  - Land Acquisition and Protection
  - Education and Public Information
  - Research and Technology Transfer
  - Reforestation Projects

When we invest in Costa Rican conservation efforts, our chance for success is maximized because of this country's:

- Progressive leadership & governmental stability
- Exemplary educational system
- Strong tradition of scientific research
- Welcoming attitude toward international partnerships
- High priority for conservation efforts, with nearly 27% of its land placed into national parks and preserves

The Center is involved with other projects in Panama, Ecuador and Mexico working closely with NGOs and research stations. The Centro de Estudio Ambiental is forging new relationships with environmental groups throughout Latin America.

TREE

AMIGOS™

Center for Environmental Study
Centro de Estudio Ambiental

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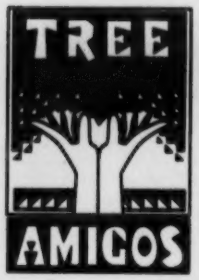
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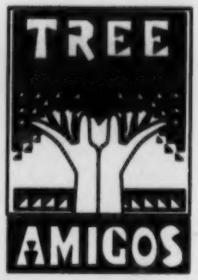
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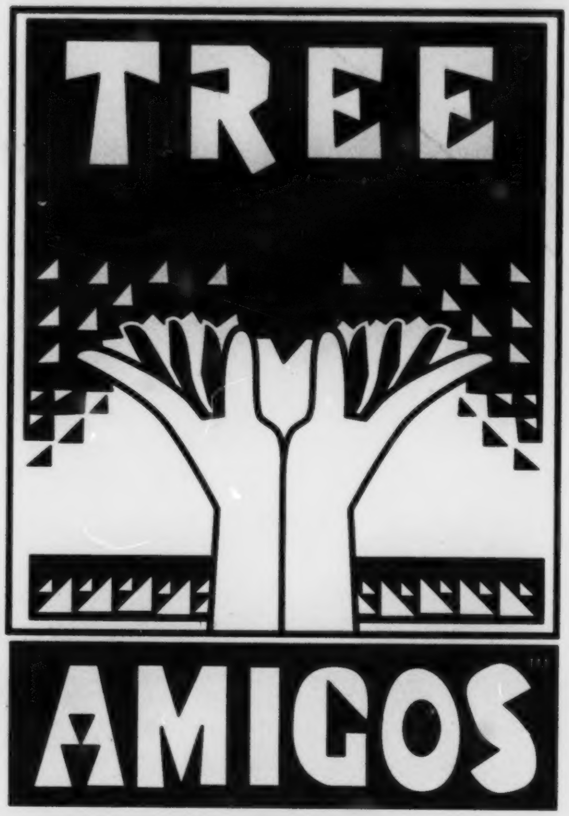
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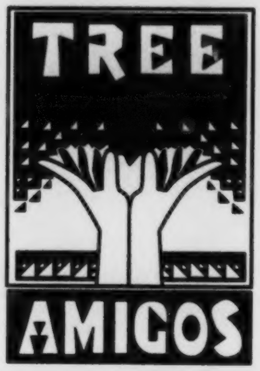
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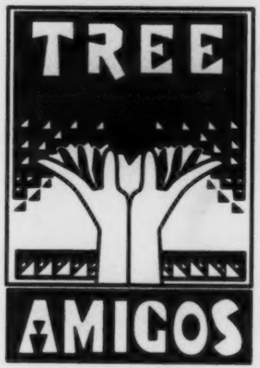
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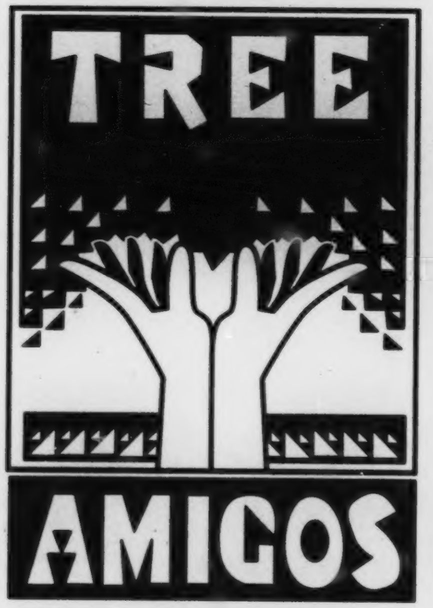
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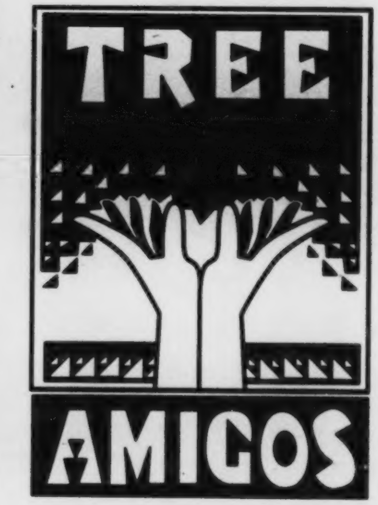
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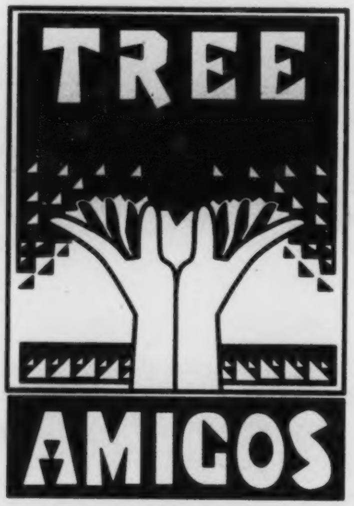
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TREE AMIGOS™

In Recognition of Your
Commitment to the Preservation
and Protection of the World's
Tropical Forests.

____
NAME

____
The Tropical Forest Fund of the Center for Environmental Study

______________________ ______________________

Kay T. Dodge, Ph.D.
President

Douglas A. Wallace, Ph.D.
Chair of the Board

Center for Environmental Study
Centro de Estudio Ambiental

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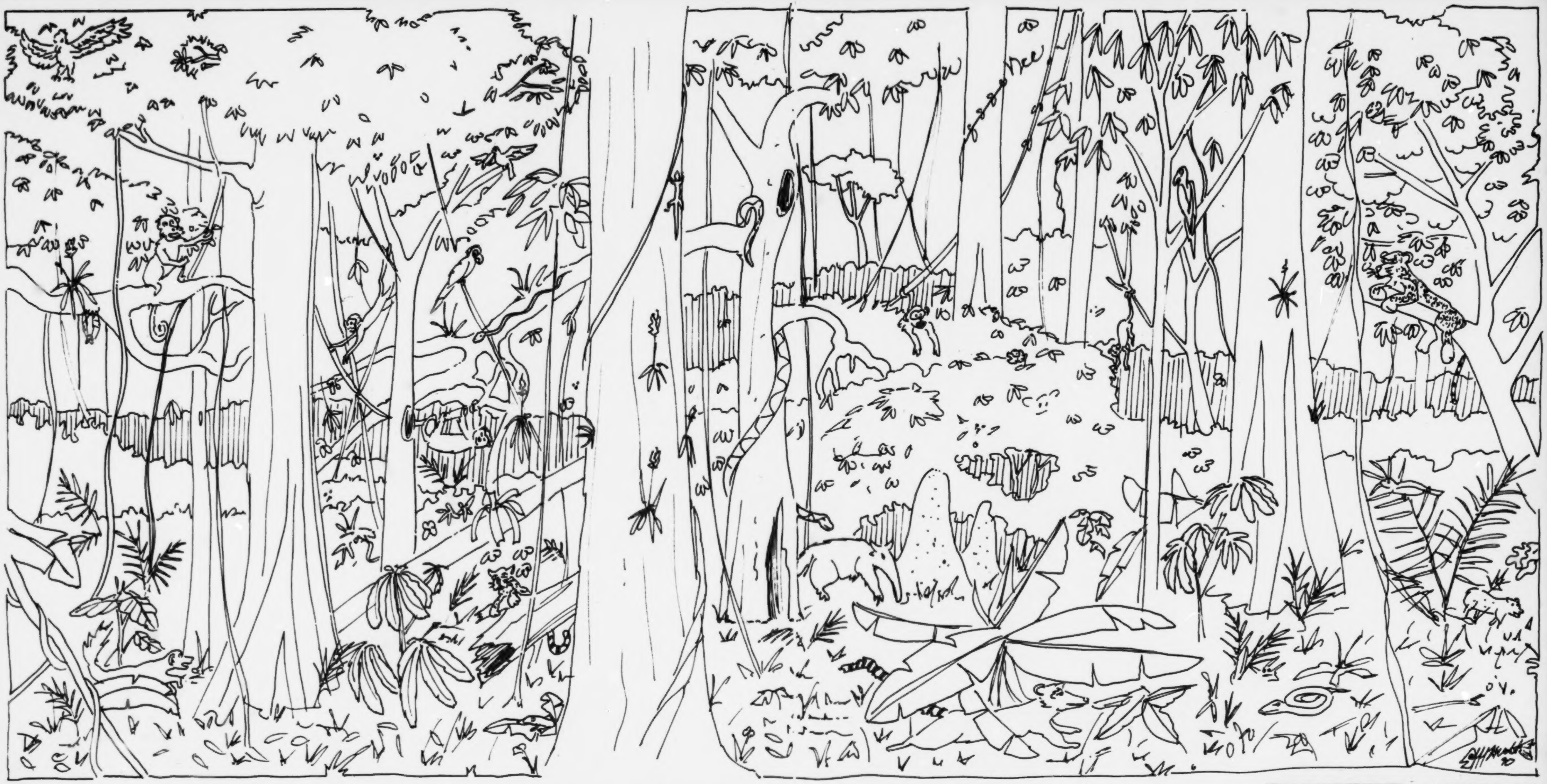
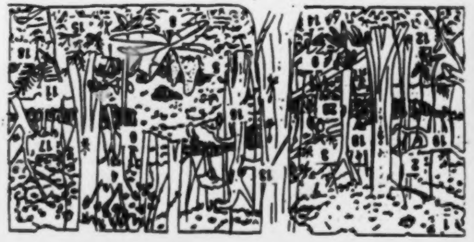


TREE AMIGOS

The tropical rain forests of Latin America host an amazing collection of plants and animals. You can find some of the world's tallest trees and some of the most interesting creatures in these special places. Take your own jungle adventure and see how many tropical rain forest animals you can find hidden among the trees in this picture.

We want kids of all ages to become Tree Amigos to help protect our world's tropical forests. Call or write for more information about how you and your school can get involved.

1 HARPY EAGLE
2 EMPEROR TAMARIN
3 GOLDEN PARAKEET
4 MACAW
5 ANTEATER
6 SPIDER MONKEY
7 TOUCAN
8 TAYRA
9 OCELOT
10 SQUIREL MONKEY
11 PURPLE HONEY CREEPER
12 COATI
13 LIZARD
14 TREE FROG
15 YELLOW VIPER
16 PYTHON
17 JAGUAR
18 PACA
19 FRUIT BAT
20 THREE TOED SLOTH



Center for Environmental Study • 143 Bostwick N.E. • Grand Rapids, MI 49503 • (616) 771-3935 • Centro de Estudio Ambiental • APDO 347-2120, San Francisco de Guadalupe, San Jose, Costa Rica • (506) 22-66-08

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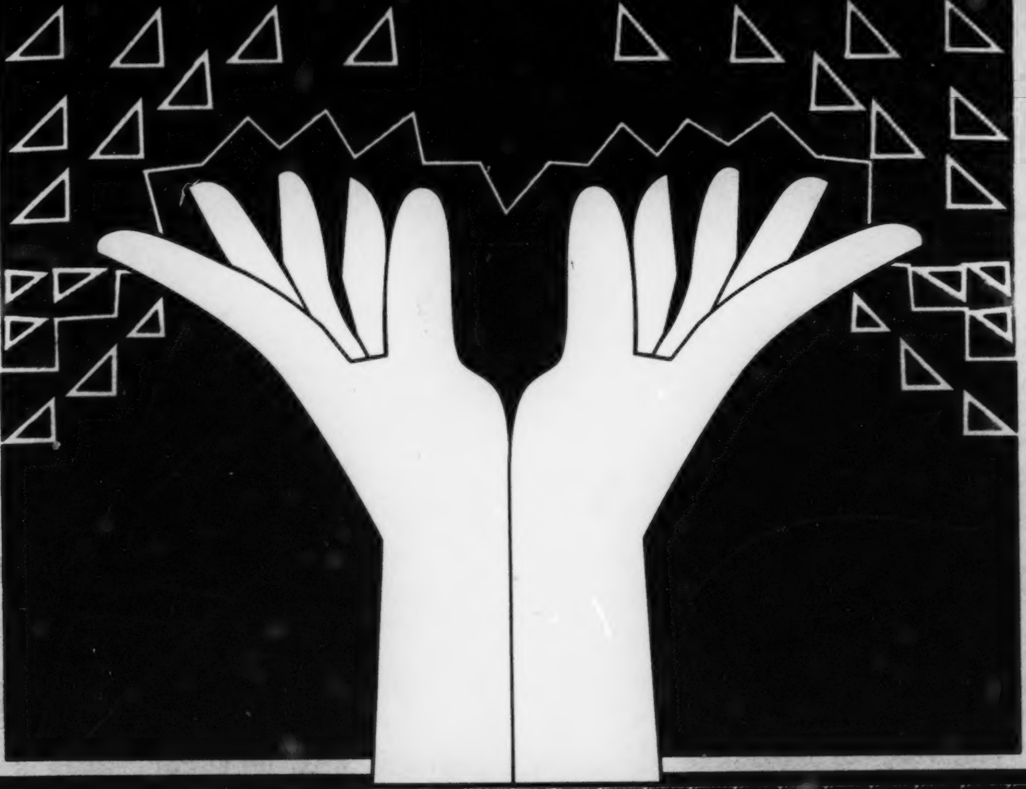
LEARNING ACTIVITIES

TREES
ECOSYSTEMS
LAND USE
PEOPLE & RESOURCES
REDUCE REUSE & RECYCLE



Since children learn best by doing, this section contains a lot of things to do. These learning activities can be used to help reinforce concepts related to action projects involving a classroom, school, or community.

Each Learning Activity Section has its own set of important ecological concepts. We hope you will integrate these into a variety of study areas including science, social studies, language arts, mathematics, the arts and others.

LEARNING ACTIVITIES

TREES

TREE CONCEPTS

PLANT STRUCTURE AND FUNCTION

PHOTOSYNTHESIS

CYCLES OF NATURE

ECONOMIC VALUE OF TREES

RENEWABLE RESOURCES

WORLD FOREST TYPES

FOREST STRUCTURE

PRESERVATION AND PROTECTION

IMPACT OF DEFORESTATION AND REFORESTATION

RELATIONSHIP BETWEEN TREES AND US

TREE AMIGOS ACTIVITY

LEARNING ACTIVITY: *Tree Amigos Journal*

OBJECTIVE: *Improving writing skills*

AGES: *Third through Sixth Grades*

MATERIALS:
Paper
Pencil or Pen
Colored Pencils, Crayons, or Markers

DESCRIPTION: *This activity provides an opportunity for students to create a journal which expresses their attachment to trees and the natural environment.*

DIRECTIONS:

1. Have students fold a piece of sturdy paper in half and have them draw a picture of their favorite tree on the front. Secure folded sheets of writing paper inside to make a journal dedicated to a favorite tree. The tree could be one they've planted, or "adopted," or one to which they have a special attachment.

2. Share the following notes on keeping a journal with your students:

   a. Journals are used to write down thoughts and ideas to use at a later time.
   b. Journals are used by scientists, authors, inventors and others to keep track of their thoughts.
   c. It is important to put titles on pages and date journal entries so that you are able to easily return to your written thoughts at a later time.
   d. Different kinds of writing can be put into your journal, such as poetry, essay, songs, quotes from other people, etc.

3. Here are some ideas to help your students begin to tap their active imaginations:

   - Imagine two trees, one old and one young, could pick their roots out of the soil and walk on them without being harmed. Then imagine that the three of you take a journey to a place none of you have seen before. Write a story in your journal about your trip. What did you encounter along the way? How did you each help each other?

   - Imagine that you are a tree. Record your moods during different times of day and during different seasons.

   - Write a letter to your favorite tree and your hopes for its future.

LEARNING ACTIVITY: *An Introduction to Trees as Branching Design Systems*

OBJECTIVES: *Understanding Energy and Photosynthesis; Tree, Leaf and Root Structures; Carbon Dioxide-Oxygen and Nutrient Cycles.*

AGES: *Fourth through Sixth Grades*

MATERIALS: *Paper*
Colored Pencils, Crayons, or Markers

DESCRIPTION: *These lessons represent a portion of "Interplay! Designs for Environmental Awareness" created by Marta Swain. These particular activities have been developed specifically for "Tree Amigos." Recognizing trees as subjects for inspiring global environmental awareness and respect, these activities will help establish understanding and appreciation for trees and our connection to them.*

For more information on "Interplay! Designs for Environmental Awareness" contact Marta Swain at (616) 459-4469, 514 Lakeside Dr. SE, Grand Rapids, Michigan 49506.

CONSIDERING OUR CONNECTION TO TREES

LESSON 1. ENERGY

CONCEPT:
Our body design, and the design of all plants and animals, is structured for survival. We are each organized by nature according to need. We relate to one another, and we can use the similarities in our designs to understand the connections that all living things share.

EXERCISE:
Stand straight, relaxed, and feel the top of your head lifting toward the sky. Close your eyes and take a deep, long breath. Exhale slowly, and feel all the parts of your body; think of line; picture it. Try to visualize what kind of energy is inside you now.

Use line to show what it might look like if you could see it.

Imagine the sound it might make. What is its source? Its center?

How does it move through your body? With what color would it fill your body? Fill a page with your energy lines, and let the line and color create a design or symbol to represent your energy.

Describe it in a sound. Describe it in a word--perhaps one you invent.

Close your eyes and imagine standing beneath a tree you know on a windy day. Look up into its branches and leaves, and use line to show the energy/movement of the tree top; hear it...fluttering and flashing air, light, sound. Recognize the line design--a system of branches supporting, reaching skyward through space with arms full of leaves to absorb sunlight and to produce energy for life.

Draw this type of line design/system.

CONCEPT:
Imagine yourself a leaf. Every leaf reaches out, a structure for absorbing light, supported by its framework of veins. Each will turn its face sunward at the angle that will allow them to absorb the most light. Green pigment in the leaves takes in sunlight energy to power photosynthesis. With this light energy from the sun, carbon dioxide from the air, and water from the earth (through the roots), leaves can make food and transfer energy to the rest of the tree. This is a miracle, or a real bit of magic, as far as we can understand. Only plants can make this happen; all other living things depend upon plants for their survival.

EXERCISE:
Using different shades, create blends of green and yellow to show leaves working during the day in the sunlight, making energy.

Listen for a sound this process might make. Is it anything like the sound of your own inner energy?

Not all leaves are getting direct sunlight at all times. Show light and dark variations of greens--greens in sunlight and greens in shade. Show all the different positions or angles in relation to the sun that the leaves on a single tree might be at one time.

Create a mark to represent energy. Place these energy "signs" in the places (leaf faces) where photosynthesis is occurring.

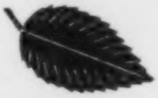
CONCEPT:
Leaves also give oxygen back into the air, which we and other animals need to breath.

EXERCISE:
Create a color to represent oxygen, and show it being released into the atmosphere we share with the plants.

CONCEPT:
Trees also need oxygen, to help release energy for growth. Cells in the tree's leaves, twigs, branches and trunk all absorb oxygen from the air.

EXERCISE:
Using the color for oxygen, show it entering these parts of the tree.

LESSON 2. LEAF LIFE LINES



CONCEPT:
Veins in a leaf reach in a branching line design to almost every one of its cells. They send sugar out of the leaf to the rest of the tree, and deliver water and minerals into each cell.

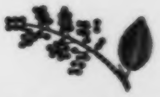
EXERCISE:
Look at a leaf and try to find all the "life lines," starting with the largest ones and following them into the tiny network of lines they become. Draw a tiny portion of the leaf's line design. When you think you've found the smallest lines, hold it up to the light and look for even smaller ones. See if you can find the tiniest lines that help the whole tree to survive. Where have you seen this kind of design before?

CONCEPT:
You, too, have this type of life line system. Some of the lines are as small as those in a leaf. They are veins and arteries that carry life blood through to every tiny part of you by means of a branching design. They are all connected to each other, the large ones branching off into smaller ones, small ones branching off into even smaller ones, and those veins branching into tiniest vessels, all carrying blood and nutrients to help us survive. The flow of blood and nutrients affects your health, and the way you feel, and even your energy level.

EXERCISE:
Compare the structure of a leaf to the design of your hand. Your veins and arteries reach into every part of your hand, your palm, thumb and each finger. Look for the larger vessels on the back of your hand; touch them; follow them. Imagine the blood moving through. You can feel the pumping of blood through these vessels by means of your beating heart, the "mainspring" of this system, a muscle that works nonstop throughout your lifetime.

Make a simple design of a pump that might be able to work endlessly for an entire lifetime.

Try to find your pulse by being very quiet and still, concentrating on being aware of a place where you can sense a beating sensation somewhere in your body. Be very active for 20 seconds, and try to sense a pulse in a quiet and still body immediately afterwards. Place your thumb over the inside of your wrist, and feel for a beat.



CONCEPT:
Nutrients are being pumped through your body, out into arms, hands, and fingers, down into legs, feet and toes.

EXERCISE:
Extend your arms, and feel the energy/movement. Draw a map of the veins that you can imagine feeding all parts of your hand. Some of these you may be able to see on the back of your hand. Fill in the veins you think might be needed to nourish every cell in the space between these; color theme with different shades of red, blue and purple.

LESSON 3. UNDERGROUND BRANCHING SURVIVAL SYSTEM

CONCEPT:
Compare your body to the design of a tree. Your whole body's need for blood and nutrients depends on the life lines of veins and arteries moving blood from your heart up into your head, down and out through your limbs, hands and feet and back again. A tree's energy/food is sent all the way from the tree's top leaves, down to the smallest and farthest roots to help them grow.

EXERCISE:
Imagine the strength of a tree. Hold your arms up, branching off your main body, reaching up, and out. How long can you hold them up/out?

CONCEPT:
Imagine your branches/limbs covered with leaves, your survival depending on your ability to hold up your limbs. Trees have a system of branching lines in the earth to help support their weight. Think of the tree's branching survival system below the ground..."life lines". Roots push down and reach out to absorb water and nourishment from the earth. They go down as far as they need to find water and nutrients. Tap roots are the primary roots, largest of all underground "branches." They usually go directly downward. Roots in the tropical rain forest do not go down deep into the ground, because nutrients are at the surface and are used up before they have time to seep down into the earth very far.

EXERCISE:

Draw the underground energy of a primary root. From the top and along the length of this root show smaller roots reaching, branching out into the ground. Some of these are as thin or thinner than the hair on your body. Show even smaller roots pushing their way through the earth--(your paper), branching into every space.

Color this root energy system, using a different color for every root size.

Create a sound to represent the sound/strength of your differently sized roots as you push them through the ground; primary root; secondary root, rootlets.

CONCEPT:

Tiny root tips are covered with caps of cells filled with water from the earth. They push their way through solid ground and can create enough force to break rock.

EXERCISE:

Create a picture to help show this phenomenon.

Create a pattern of marks to represent the unique energy of these "power lines." (Think of how you might show electricity, and then draw a picture to show the energy in root strength.)

CONCEPT:

Each of the millions of rootlets are covered with tiny root hairs which are most efficient at absorbing water and dissolved nutrients from the soil for survival. Much of the tree's needs are supplied by roots that send water and nutrients all the way up from the tiniest root in the ground to the highest leaf at the tree top. Roots, like leaves reach out for the things they need to survive. Most of the water and nutrients are near the surface. Through the youngest layer of wood in the tree's trunk, called the sapwood, microscopic "pipelines" carry water and minerals up from the root hairs, rootlets, and bigger roots to nourish all the rest of the tree.

EXERCISE:

Using line, create a design to show the different directions water moves inside a tree to supply it with what it needs.

Imagine the line design made up of all the veins and arteries carrying blood through your body. Imagine the branching system of all the veins, pipelines, and roots of a tree.

Close your eyes and imagine that those are big enough for you to travel through. They take you all around, from top to bottom, through the survival mechanisms of the quiet, living giants of still and stable strength, and through similar "life line paths" of active and able human bodies. From leaves and hands through branches and arms, trunks and torsos, into roots and legs, rootlets and feet, holding ground.

Try to sense the energy within these beings, the pumping of their life "blood", keeping them alive and healthy.

Try to imagine standing as straight and strong as a tree, and feel roots sending nutrients up through the trunk and branches to the leaves, and back down with food/energy for growth.

CONCLUSION:

The branching design of a leaf relates to our system of life supporting "line design," and to that of the entire tree.

Living things as well as non-living things, are made up particles-molecules, atoms, and electrons that combine in "growth" to follow basic laws regardless of whether the combination occurs in bodies we see or think of as alive or inanimate. To recognize these inter-relations, and the connections they represent, is to become familiar with our biological world.

The healthy survival of the human race, and the trees and animals with whom we share the earth, water supply and atmosphere is dependent on our understanding of how life exists. We are wise to pause and exercise our awareness of the natural world around us and to measure the demands we place on the earth and its resources.

Uses of Trees

Introduction: A lumberjack saved Paddle from the saw at the sawmill. But the log that had carried Paddle went on through the sawmill and was made into lumber. Many other products come from trees as well.

Objectives: When students have completed this activity, they will be able to list at least five products that they use in their daily lives which come from trees. They will be able to give examples of at least three different categories of products from trees.

Materials: Uses of Trees list

Procedure:

1. Ask students to think of as many products from trees as they can. Products from trees include all kinds of wood products, paper and food items, among other things. How do students use these products in their daily lives?

2. How did American Indians use trees? The Chippewa were expert at building canoes from birchbark (build your own model birchbark canoe using the directions in this guide). They also made baskets and built homes from wood and bark. Dyes from bark, roots and fruits were used to color clothing and crafts. Trees provided food as well.

3. Study the **Uses of Trees** list. How many of the uses shown here did you think of? Did you think of any that are not on this list? What uses seem unusual to you?

4. Make a bulletin board or set up a display table to illustrate different uses of trees. Have students bring in examples or pictures of products from trees. Draw pictures showing products from trees and how people use them. Make labels for different products and/or different categories of products (building materials, furniture, food, etc.).

5. Play an alphabet game with products from trees. Try to think of products that begin with each letter of the alphabet (A for apple, B for boat, C for charcoal, etc.). How many of these are represented on your bulletin board or display table? You may want to consult an encyclopedia for more information about the uses of trees.

USES OF TREES

WOOD PRODUCTS

- Airplanes
- Barrels
- Baseball bats
- Baskets
- Boats
- Bowling pins
- Boxes
- Bridges
- Building materials
- Cabinets
- Caskets

- Charcoal:
  - Explosives
  - Filters
  - Fuel

- Crates
- Doors
- Fenceposts
- Flooring
- Foundations
- Furniture
- Matches
- Mine timbers
- Musical instruments
- Paneling
- Pencils
- Plywood
- Railroad ties

- Sawmill wastes:
  - Bedding for animals
  - Fuel (wood alcohol)
  - Insulation board
  - Packing materials
  - Particle board
  - Pulp chips

- Shingles
- Signs
- Telephone poles
- Tongue depressors
- Toothpicks
- Toys
- Veneer
- Window frames

- Wood pulp:
  - Acetate
  - Cardboard
  - Cellophane
  - Paper
  - Photographic film
  - Plastics
  - Rayon (fabric)

OTHER FOREST PRODUCTS

- Bark:
  - Adhesives
  - Cork
  - Dyes
  - Fuel
  - Soil mulch
  - Tannic acid

- Fruit:
  - Apples
  - Beechnuts
  - Black walnuts
  - Blueberries
  - Cranberries
  - Hickory nuts
  - Oranges
  - Pecans
  - Pine nuts

- Gum:
  - Pine oil
  - Rosin
  - Turpentine
  - Varnish

- Leaves:
  - Cedar oil
  - Holly
  - Wreaths

- Sap:
  - Maple sugar
  - Maple syrup

"Paddle to the Sea"
Ohio Sea Grant Education, Ohio State University
059 Ramseyer Hall
29 West Woodruff
Columbus, OH 43201

Trees Around the World

Match clues to pictures of some special trees around the world.

Objectives:
Name three unusual trees. Discuss a special feature of each of these trees. Point out on a map where these trees grow.

Ages:
Intermediate and Advanced

Materials:
- ***copies of page 33 and the clues below***
- ***reference books***
- ***map of the world***
- ***tape***
- ***scissors***

Subjects:
Science and Geography

Can you imagine a tree that's as old as the pyramids? What about a tree with "knees"? In this activity your kids can learn about these and other unusual kinds of trees. They can also brush up on their geography skills by pointing out on a map where the trees grow.

Divide your group into teams of four and give each child a copy of page 33 and the clues below. Explain to the kids that they'll be using research books to match each of the pairs of clues below with the picture of the tree on page 33 that the clues describe. The first clue in each pair tells about a special characteristic of that tree, and the second clue refers to the place where the tree grows.

You can give the teams time to do a little research each day, or you can have them work completely on their own time. To match the clues with the pictures, have the kids write the number of each clue pair in the space provided under each picture. (All of the members of a team can work on all of the clues, or each child in a team can be responsible for finding the answers to two or three of the clues.) Tell the kids that they should also make sure they can find the area on a world map where each tree grows. To add an extra challenge, you might want to set a time limit.

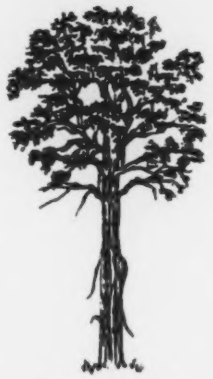
When you're ready to go over the answers with the kids, cut out the tree pictures on page 33 and spread them out on a desk or table, along with a roll of tape. Display a map of the world in a place where everyone can see it. Then read the first set of clues and ask one of the teams if they can say which tree the clues refer to. Discuss their answers (correct answers are listed on the inside back cover), then have one or two of the members from the team find the appropriate picture from the ones you've cut out. Next have them tape the picture to the map in the correct country or state. Call on another team for the answer to the next set of clues, and continue until all the tree pictures have been placed "around the world."

AROUND THE WORLD CLUES

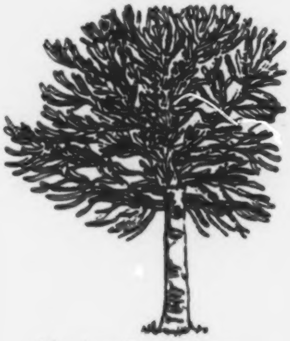
1. - *one of the oldest living things in the world*
   - *grows in the U.S. in a state where one of the largest and rarest birds in North America (a type of vulture) lives*
2. - *trunk can have a circumference of 40 feet (12 m)*
   - *world's largest desert is located on the continent where this tree grows*
3. - *lives in swampy habitats and has "knees" that stick out of the water*
   - *the mouth of the Mississippi River is located in one of the states where this tree grows*
4. - *roots grow down from this tree's branches*
   - *Bombay is a major city in the country where this tree grows*
5. - *can store hundreds of gallons of water to help it survive in times of drought*
   - *grows in parts of Mexico, California, and in the U.S. state that contains one of the deepest natural wonders in the world*
6. - *twisted branches and spiny leaves might make this tree a challenge for even a monkey to climb*
   - *is a native of the southernmost South American country*
7. - *was abundant when the dinosaurs were alive*
   - *is a native of the country where gunpowder, silk, and paper were first made*
8. - *one of the tallest trees in the world*
   - *wombats and koalas are native to the continent where this tree grows*
9. - *some bulletin boards and bottle "stoppers," and also the centers of baseballs, are made from a part of this tree*
   - *one of the main countries this tree grows in is the same country Christopher Columbus set sail from in 1492*

"Trees Are Terrific" Ranger Rick's Nature Scope
National Wildlife Federation
1400 Sixteenth St. NW
Washington, DC 20077

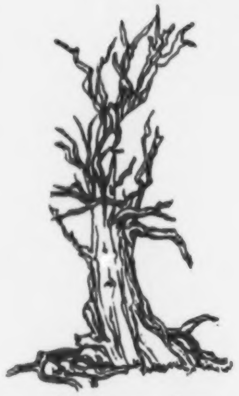
COPYCATPAGE TREES AROUND THE WORLD



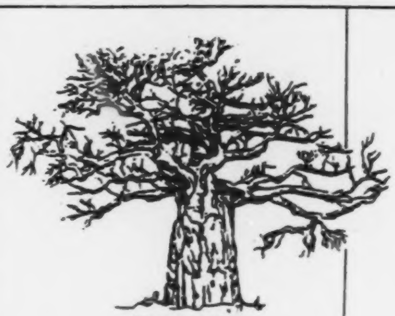
Eucalyptus Tree —



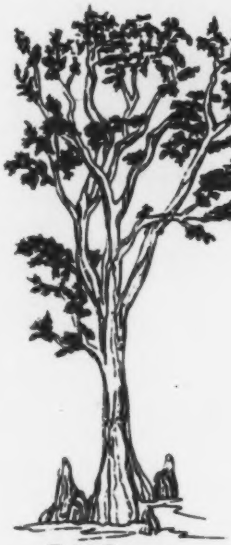
Monkey Puzzle Tree —



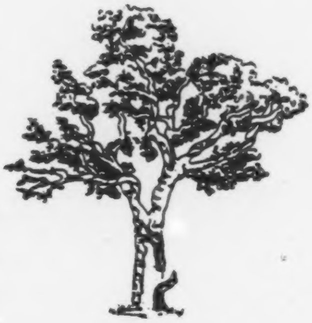
Bristlecone Pine —



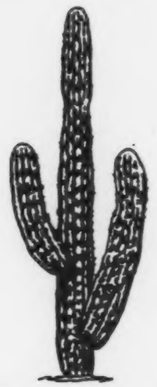
Baobab Tree —



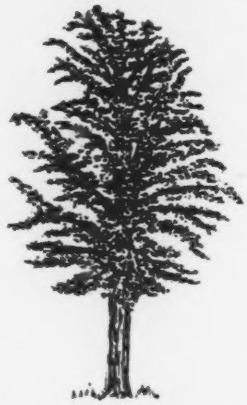
Bald Cypress —



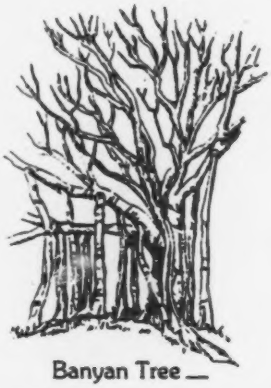
Cork Oak Tree —



Saguaro Cactus —



Ginkgo Tree —



Banyan Tree —

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COPYCAT PAGE

TREETOP EXPLORERS

The sun and wind are stronger and the rainfall is heavier in the canopy than on the forest floor.

Weather conditions can change quickly and drastically in a tropical rain forest.

To best understand how plants and animals live, scientists must study them in their natural habitats.

Animals can be frightened by unfamiliar things in their habitat. It takes time for them to get used to a scientist studying them.

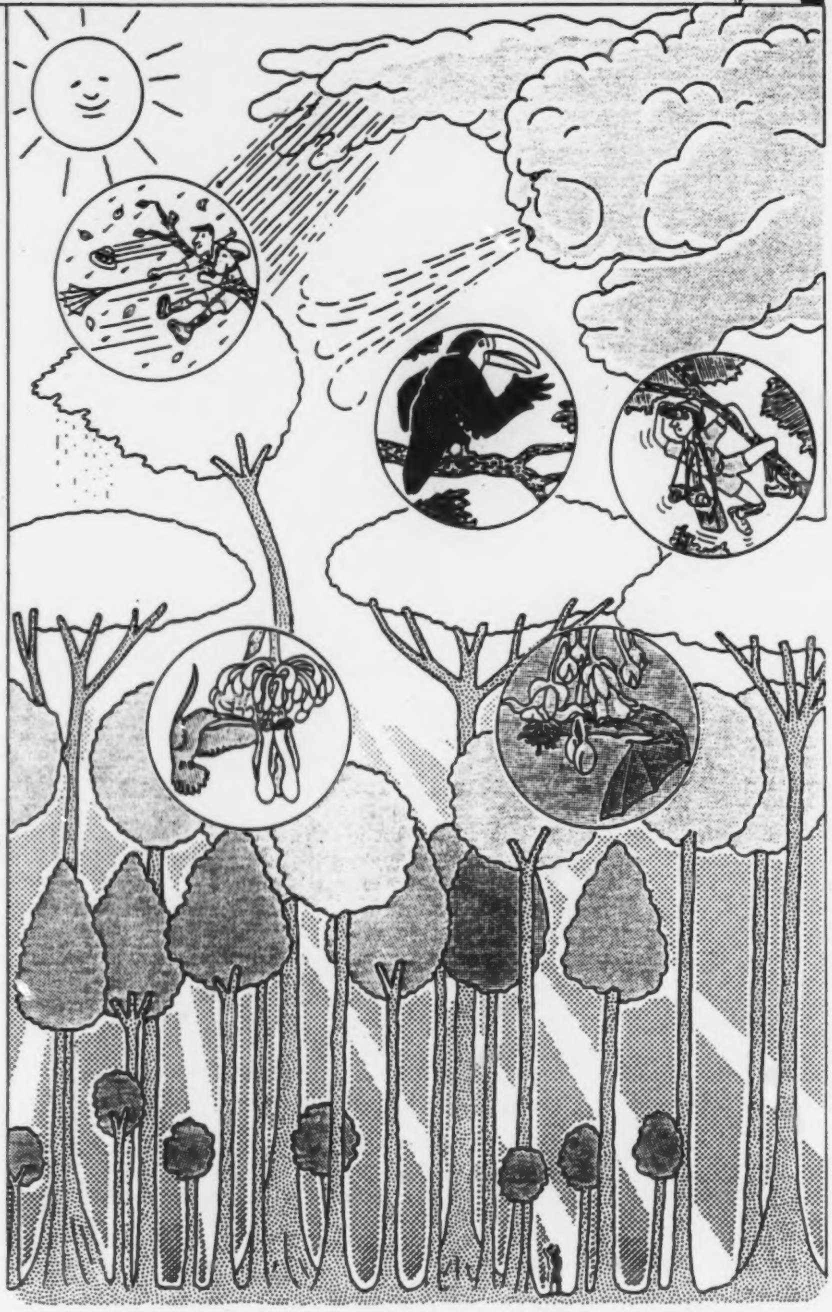
The highest branches of the canopy can be more than 100 feet above the ground. (That's higher than a 10-story building!)

The lowest branches of tall trees can be more than 30 feet above the ground.

Many canopy flowers bloom at the outer fringes of the crowns of trees.

Animals that commonly pollinate rain forest flowers include many kinds of insects, birds, and bats.

Many flowers have adaptations that attract certain pollinators. For example, flowers with different shapes, colors, and odors are pollinated by different kinds of animals.



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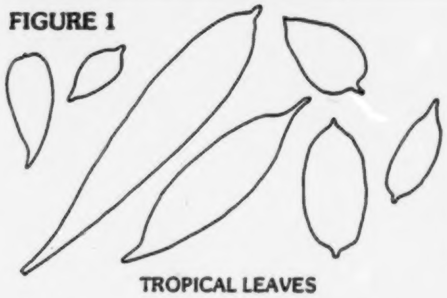
COPYCAT PAGE FOREST COMPARISONS

FIGURE 1



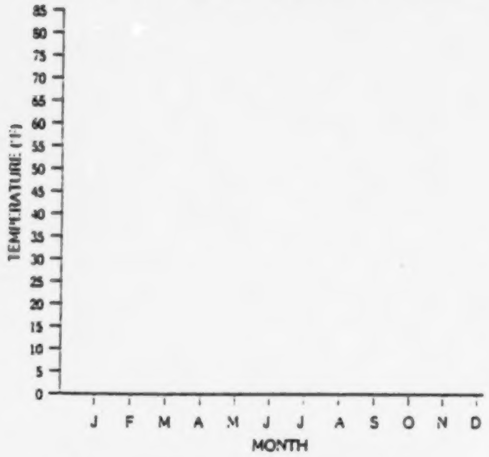
TROPICAL LEAVES

DAY LENGTH IN A TROPICAL RAIN FOREST

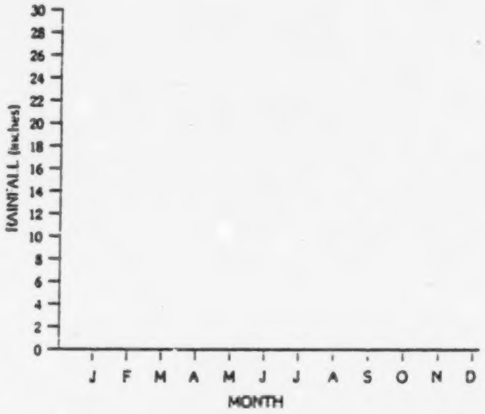
MONTH/ DAY	JAN 1	MAR 1	MAY 1	JUL 1	SEP 1	NOV 1
SUNRISE *(AM)*	5:58	6:11	6:01	6:09	6:02	5:41
SUNSET *(PM)*	6:09	6:14	5:54	5:53	6:03	5:51
DAY LENGTH						

FIGURE 2

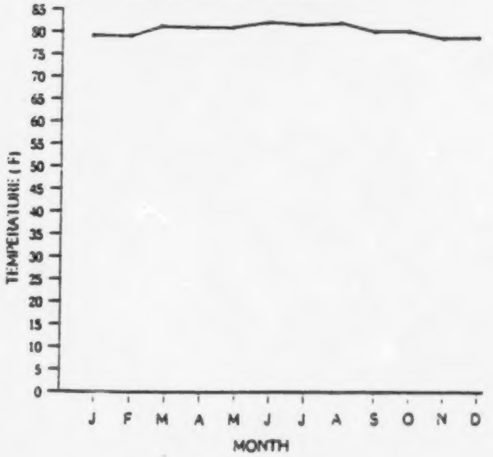
Graph A AVERAGE TEMPERATURE IN YOUR AREA



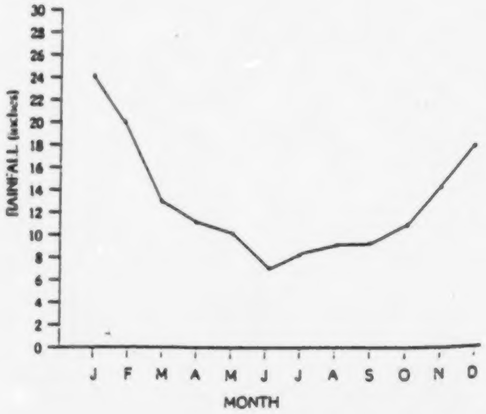
Graph B AVERAGE RAINFALL IN YOUR AREA



Graph C AVERAGE TEMPERATURE IN A TROPICAL RAIN FOREST



Graph D AVERAGE RAINFALL IN A TROPICAL RAIN FOREST



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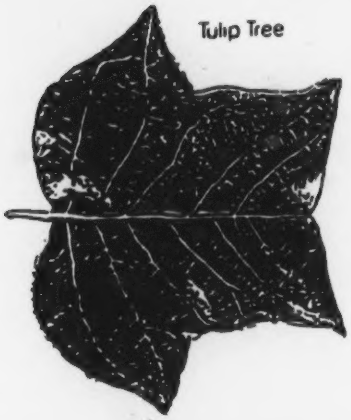
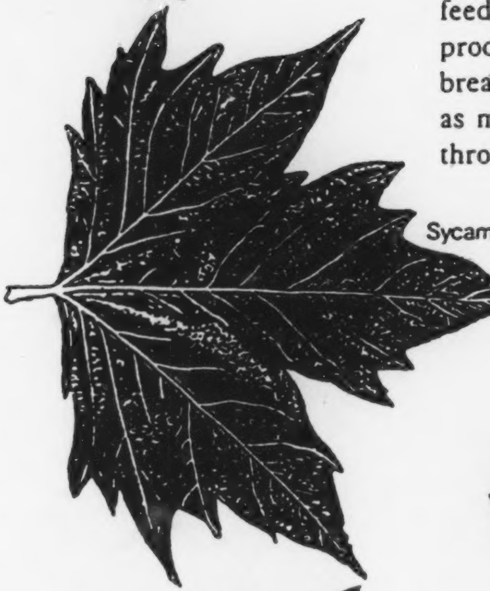
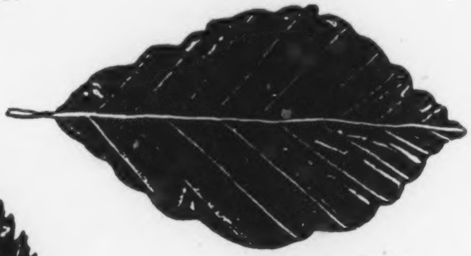
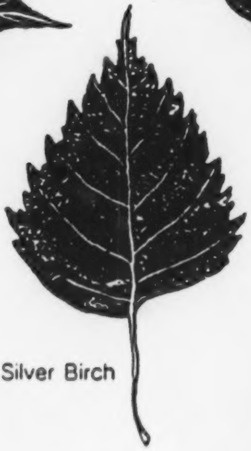

Tulip Tree

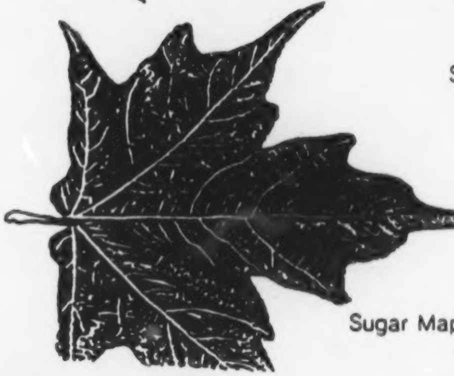
Leaves – The Food Factory

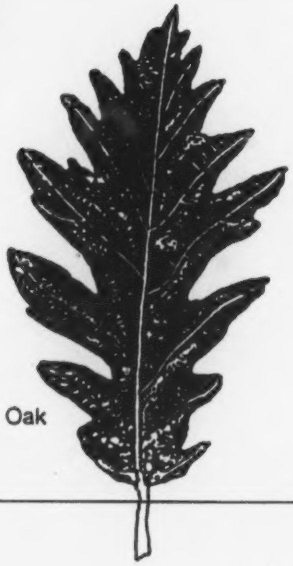
Trees make their own food by using the green coloring in their leaves, called *chlorophyll*. Production begins when energy is drawn by the chlorophyll from sunlight. The energy enables the green leaves to suck water and minerals from the tree's roots and mix them with carbon dioxide gas taken from the air. The gas and water are converted into sugars, which the tree feeds on. This process, called *photosynthesis*, also produces much of the oxygen we need to breathe. On a hot day a single tree can release as much as 150 gallons of water into the air through its leaves.


Sycamore


Common Beech


Silver Birch


Sugar Maple


Turkey Oak

"Trees and Leaves"
Althea Braitnuaite
Troll Associates, 1990
Mahuah, New Jersey 07430

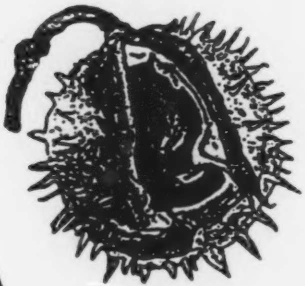
Trees Grow from Seeds

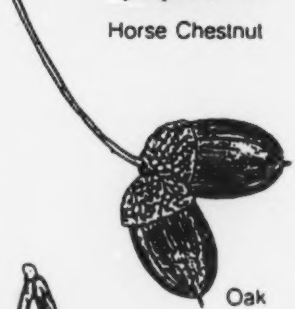
"From little acorns do mighty oaks grow" is a common saying. Oak trees live for up to 1,000 years. Yet, like all trees, they start from a tiny seed.

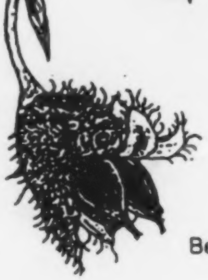
Seeds need enough sunlight and water from the soil to grow. Seeds grow better away from the shadow of their parent, so nature finds ways to scatter them.

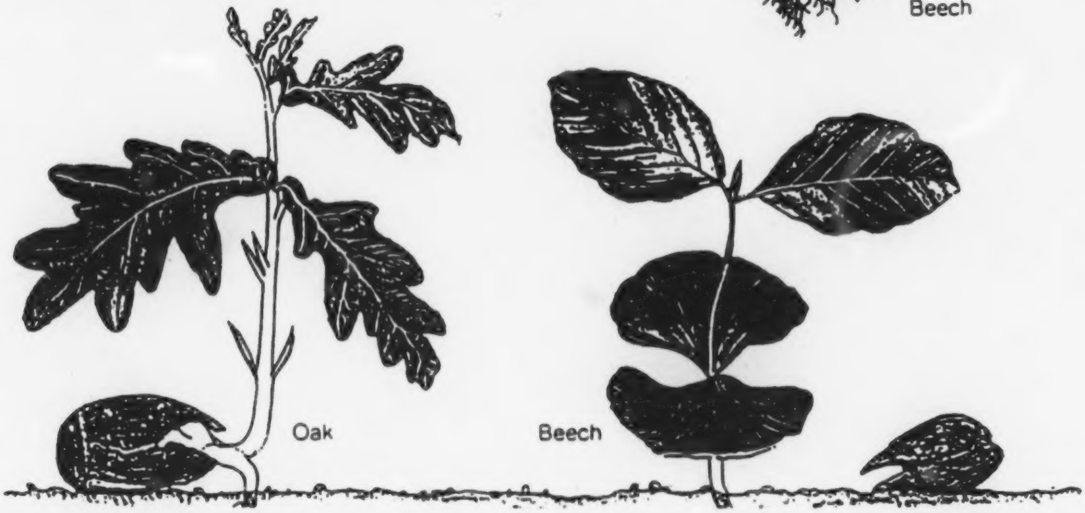
Maples produce seeds with wings to be blown by the wind. A squirrel buries nuts for the winter, when food is scarce. If he forgets one, he may have planted a tree. Birds eat berries, cherries, and other fruit. Either they spit the seed out, or it will pass through them, undigested, and be scattered in their droppings. Other seeds are carried on the water.

If you watch an acorn grow, you will see that it produces two shoots. Whichever way you plant the acorn, one shoot grows down to form a root and the other grows up to become a trunk.


Horse Chestnut


Oak


Beech



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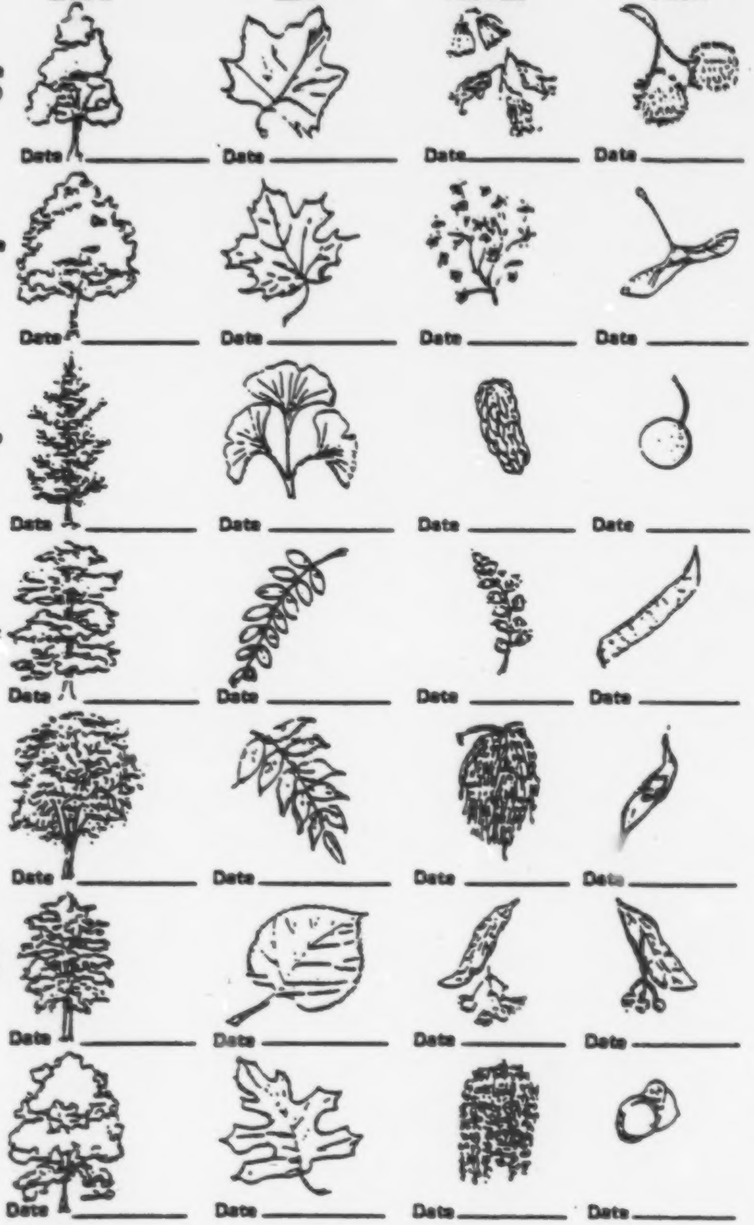
Mahuah, New Jersey 07430

Changes in City Trees

Investigate the seasonal changes of common city trees. When do leaves and flowers appear in the spring? When do fruits form? Put the date of the observation beneath the correct picture.

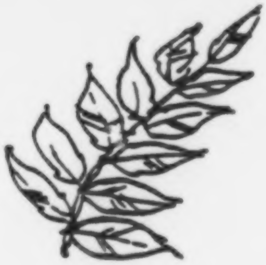


	SHAPE	LEAF	FLOWER	FRUIT
London Plane (sycamore)	Date ______	Date ______	Date ______	Date ______
Norway Maple	Date ______	Date ______	Date ______	Date ______
Gingko	Date ______	Date ______	Date ______	Date ______
Honey Locust	Date ______	Date ______	Date ______	Date ______
Ailanthus	Date ______	Date ______	Date ______	Date ______
Basswood (or Linden)	Date ______	Date ______	Date ______	Date ______
Pin Oak	Date ______	Date ______	Date ______	Date ______

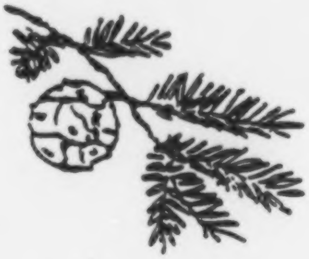
"A Teacher's Guide"
The Urban Environment
J.G. Ferguson Publishing Co. 1975
11 S Broadway
Red Lodge, MT 59068

Leaves of City Trees

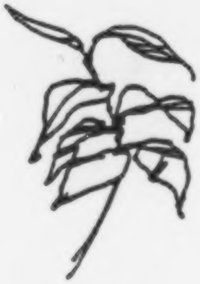
Match the leaves you have found to these pictures.



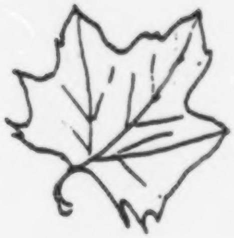
Ailanthus



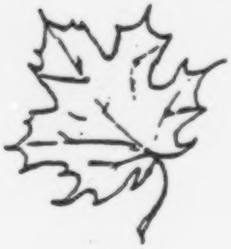
Bald Cypress



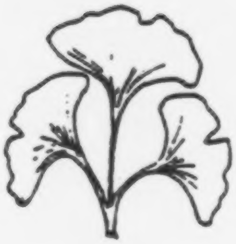
Wild Cherry



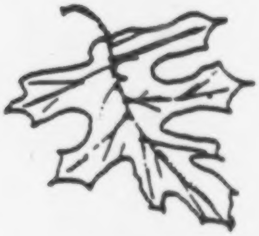
London Plane



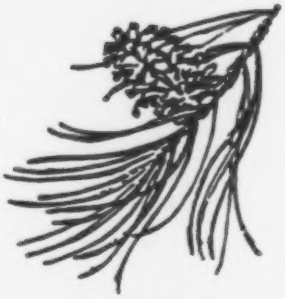
Norway Maple



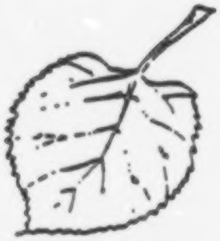
Gingko



Pin Oak



Ponderosa Pine



Basswood (or Linden)

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LEARNING ACTIVITY: *What Kind of Tree Is It?*

OBJECTIVE: *Students are provided an opportunity to learn about four common tree species common to the Great Lakes area while fostering their creativity through coloring copies of the tree species after identification.*

AGES: *3rd through 8th Grade (Tree Indentification Activity)*
Pre-school through Fifth Grade (Coloring Activity)

MATERIALS: *Copy-ready pictures of four species of trees (they follow this activity sheet)*
Coloring pencils, Crayons, Markers
Identification Key that follows this activity sheet

DESCRIPTION: There are many ways to identify trees, but the most common way is to examine the texture of the bark and the leaf shape. Trees are classified according to how they grow, the type of flower and seeds they produce, their internal structure and how they reproduce. This activity will help students identify four common trees by working with a key that guides them by the type of seed and/or leaf each tree produces.

For your convenience, background information on trees is listed on the back of this activity sheet.

- There are two main plant groups that most trees belong to:

Angiosperms: Angiosperms are flowering plants that produce seeds inside their fruit. Tree members of this group include birches, palms, oaks, maples and willows.

Gymnosperms: Plants that produce seeds which are not enclosed in flowers or fruit belong to this plant group. Most gymnosperms produce seeds on the surface of cones. the most common member of this group are pines, hemlocks, firs and spruces.

* GLOSSARY

ALTERNATE - leaves that are staggered or not placed directly across from each other on the twig

BLADE - the flat part of a leaf, or leaflet, characteristic of deciduous trees

BUD SCAR - the marks remaining after bud scales drop in spring

COMPOUND LEAF - a leaf with more than one blade. All blades are attached to a single leaf stem. Where the leaf stem attaches to the twig there is a bud.

CONIFER - cone-bearing tree

DECIDUOUS - shedding all leaves annually

ENTIRE - a leaf margin with smooth, untoothed edges

EVERGREEN - tree with needles or leaves that remain alive and on the tree through the winter and into the next growing season

LOBES - projections that shape a leaf

MARGIN - the edge of a leaf

MIDRIB - the primary rib or central vein of a leaf

OPPOSITE - two or 3 leaves that are directly across from each other on the same twig

PALMATE - leaf blades on one leafstem arranged like fingers on the palm of a hand

PETIOLE - the leafstalk that connects the blade(s) to the twig

PINNATE - leaf blades arranged in leaflets like the vanes of a feather

SAMARA - winged fruit

SIMPLE - a single leaf blade with a bud at one base of the leafstem

SINUS - indentation between lobes on a leaf

SPURS - stubby, often sharp twigs

TEETH - notches on the outer edge of a leaf

- Terms pertaining to trees are adapted from "Teacher/Leader's Guide to Michigan Natural Resources", sponsored by Michigan State Parks and Michigan Department of Natural Resources.

* The glossary is provided by "What Tree Is That?", The National Arbor Day Foundation, 100 Arbor Ave., Nebraska City, NE 68410

WHAT KIND OF TREE IS IT?

Tree Identification Key

1. Does the tree produce cones and have leaves that are needle-like? **CLUE:** these trees are called *CONIFERS* (cone bearing) and most are *EVERGREEN* →

YES, Go to #2

OR

Does the tree have leaves that are flat and thin and generally shed in autumn? **CLUE:** They bear a variety of fruit and flowers. → → → →

YES, Go to #3A OR #3B

2. Evergreen; coniferous; long needles are clustered in 5's and the cones are long with thin scales.....**WHITE PINE** *(Pinus strobus)*

3A. Simple, lobed leaves; in these trees, the blades of the leaves are divided into lobes →

YES, Go to #4A OR #4B

OR

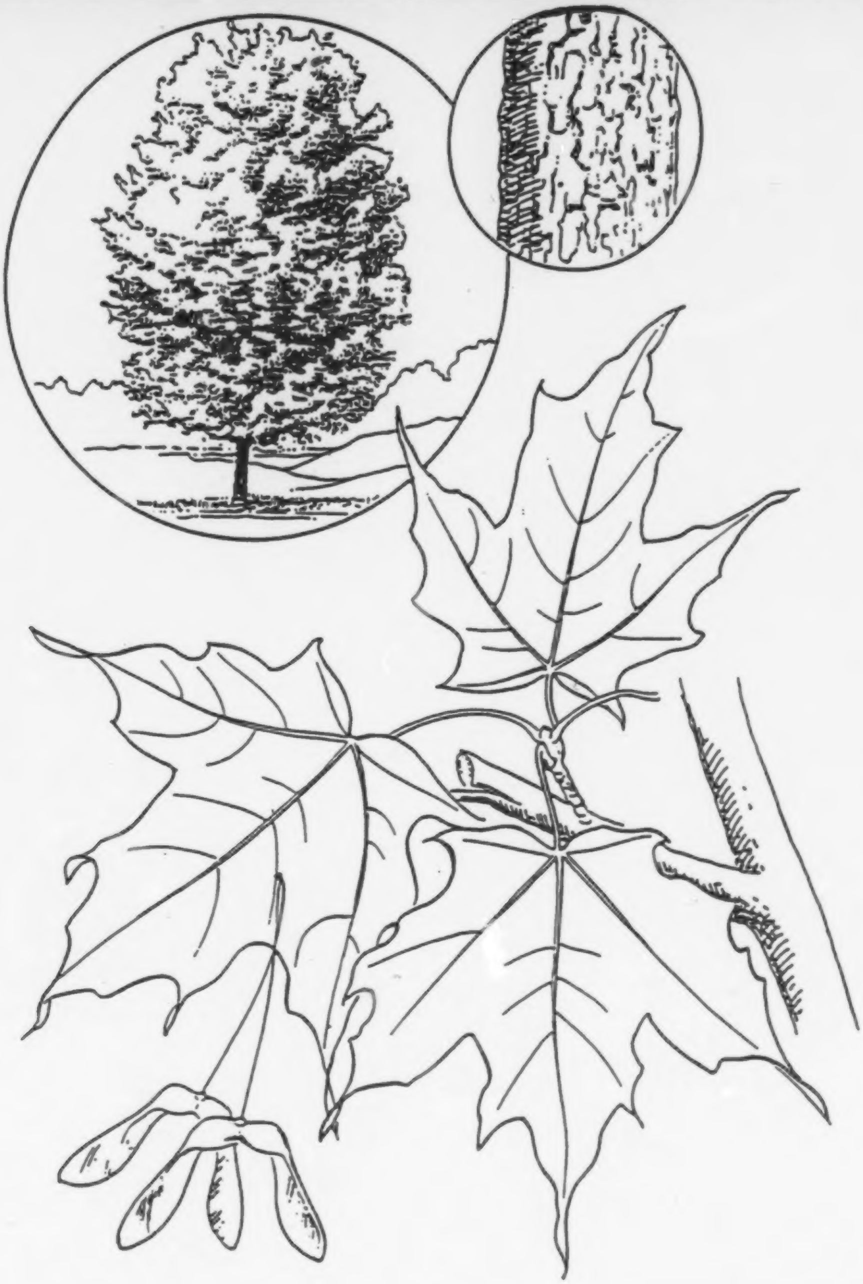
3B. Compound leaves; the blades of these leaves are divided into either a few or many separate leaflets → → → → → → → → → → → → → → →

YES, Go to #5

4A. Deciduous; fruits are produced in winged pairs that have pale green to brown, slightly, spreading wings. This type of fruit is called a "samara" and all trees in this family have these "propellers"......**SUGAR MAPLE** *(Acer saccharum)*

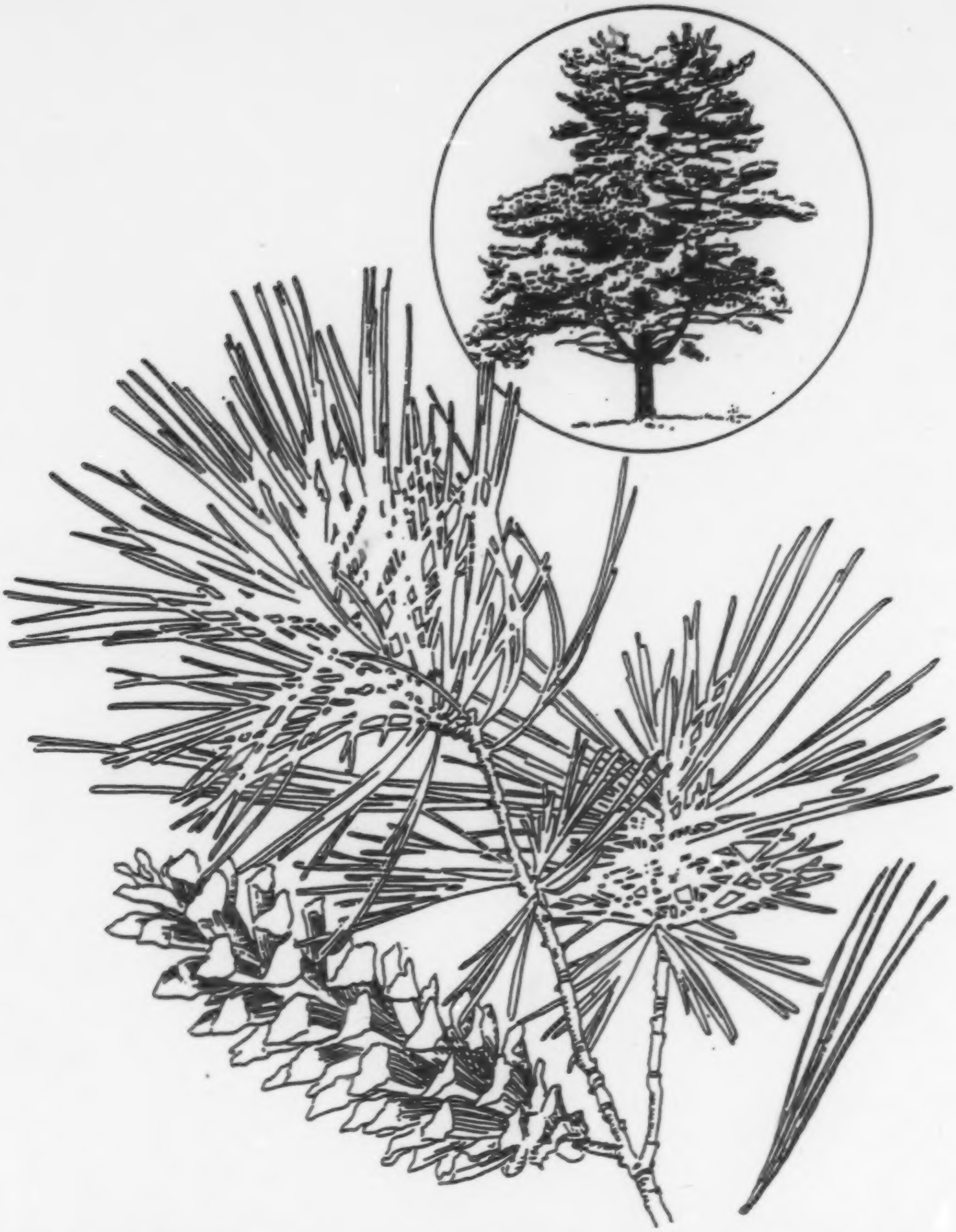
4B. Deciduous; fruits are acorns, egg-shaped which are brown when ripe in autumn with shaggy brown cups covering over one-half of the acorn.....**BLACK OAK** *(Quercus velutina)*

5. Deciduous; compound leaf, produces clusters of several thin-shelled, light brown edible nuts enclosed in thick, round husks that are green in the summer and turn brown in autumn. The husks split apart when ripe in autumn.....**SHAGBARK HICKORY** *(Carya ovata)*



SUGAR (or HARD) MAPLE *(Acer saccharum).* The state tree of New York, Vermont, West Virginia and Wisconsin. Its leaves give a magnificent display of color—red, yellow and orange—in the fall. In mature trees the bark looks as if it were cut in places and were just starting to peel. The greenish-yellow flowers, which are without petals, appear with or after the leaves. It is a good hardwood, used especially for furniture. This tree is economically important because of the maple sap obtained from the trunk, which is used in making sugar and syrup.

"Trees of the Northeast" Coloring Book
Stephan Bernath, with captions by M.E. Faust
Dover Publications, Inc., 1979
180 Varick, Street
New York, NY 10014



WHITE PINE *(Pinus strobus).* The state tree of Maine and Michigan. It is the largest of the Northeastern conifers. The needles are in groups of five. Both staminate and pistillate cones are on the same tree, the pistillate being long and drooping, without spines on the scales. Before 1860 the white pine formed vast forests but, because of the destruction caused when it was used for ship masts and lumber, as well as losses caused by white-pine blister rust disease, its number has been reduced. It was introduced to England about 1705. It grows rapidly and is a good timber tree.

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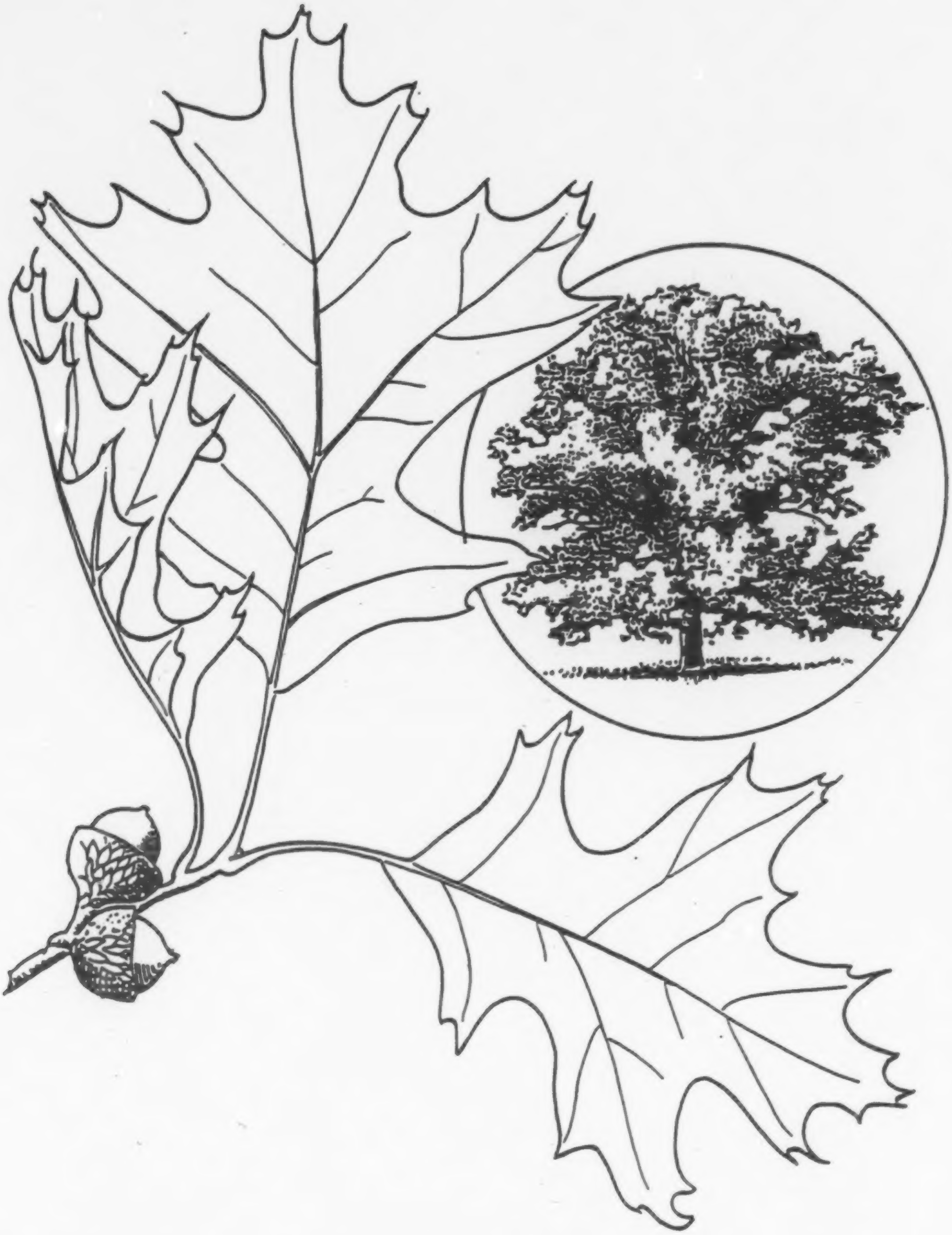

BLACK OAK *(Quercus velutina)*. The leaves are variable and bristly. The wood is often substituted for the red oak, which belongs to the same group. It is used for floors and makes a hot fire for a potter's kiln. The inner bark is orange; checking it is a good test for the species.

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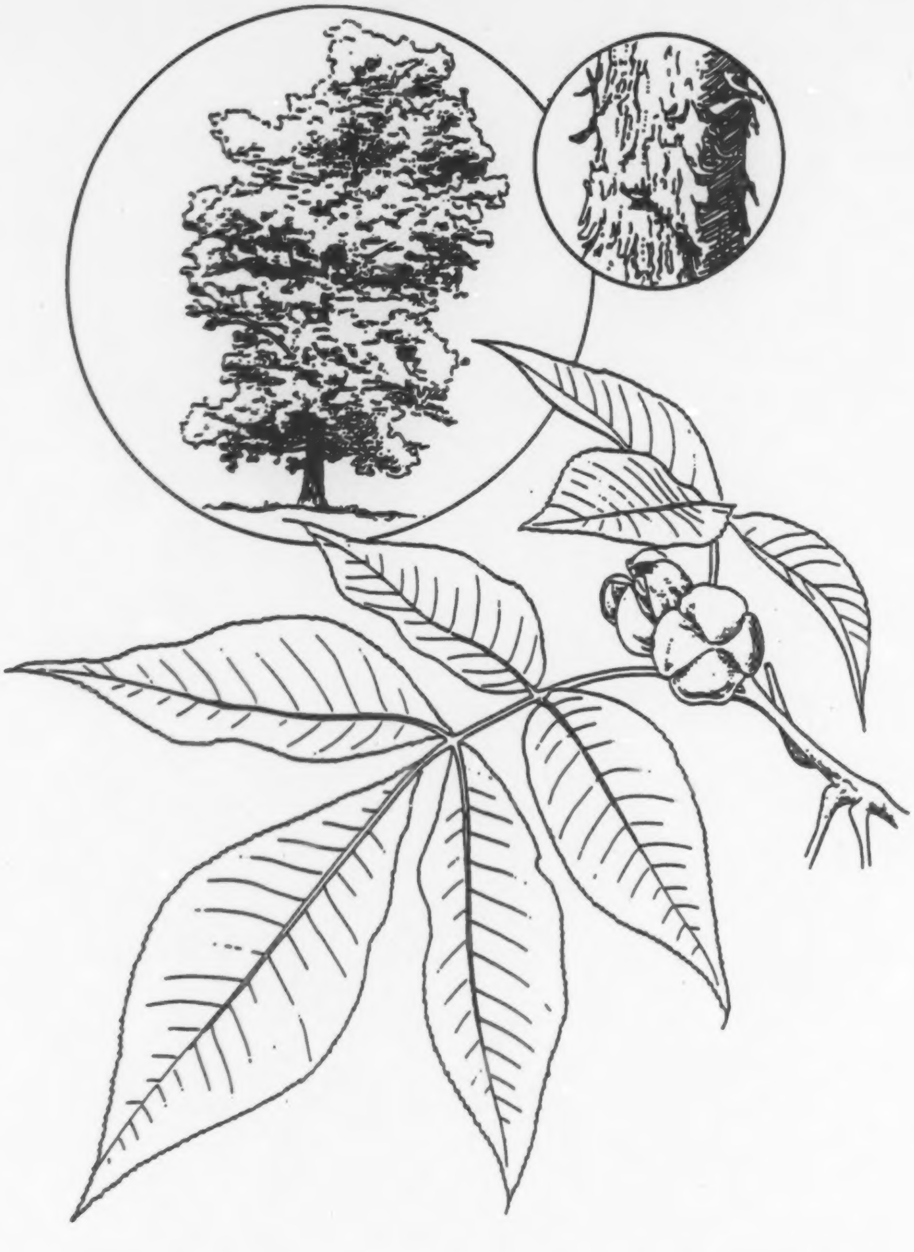

SHAGBARK HICKORY *(Carya ovata).* The pinnately compound leaves turn golden in the fall. The bark shreds, but does not loosen completely or fall off. Both the staminate catkins and pistillate flowers are on the same twig. The fruit produces a thick hull which splits into four parts, releasing a woody nut with edible kernels. Squirrels bury the nuts. If a beaver cannot find its favored aspens nearby it will eat the inner bark of the shagbark hickory. The wood is tough and good for use in tools such as ax handles. It is also good for burning, as a cord is equal to a ton of anthracite coal. The smoke from the burning wood gives the flavor to smoked ham.

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LESSON I – THE VALUE OF TREES AND FORESTS

Objective	Identify the importance of trees to humans and the environment.
Focus	Awareness of forest types, and economic and social values of trees
Outcome	The student will have an increased awareness of the different forest types around the world and the different products and benefits derived from trees.
Background	There are six different forest types around the world. Five of these can be found within the continental U.S., Hawaii, Puerto Rico, and Alaska. It is recognized that over 5000 products and by-products, as well as countless values, come from trees. Some of these are listed on the next page.
Activities	Discuss, as a class, the five different forest types and their locations on the map provided. Identify which forest type you live near. Discuss, as a class, the areas of daily life that are influenced by trees. Make a personal, class, or grade-level list of benefits derived from trees in our lives (products, by-products, values, etc.).
Materials	List of tree values Tropical forest map Materials for scrapbook: string 2 pieces of 1/4" cardboard (cut 12" x 12") contact paper glue newspapers ring binder
Procedures	Ask students to suggest how trees or tree-related products play a role in their own lives. They may be reminded of areas including the natural environment, home, school, food, music, art, jewelry, transportation, and recreation. Magazines and other materials from the media center or classroom library may be provided as resources, and students may work either individually or in commitees. This can be expanded to a class or grade-level list and added to as the week progresses, possibly making the activity a contest between classes.
Extensions	Select and report on the uses of different types (conifers or deciduous) or species of trees (oak, cedar, pine, maple, etc.). Develop a scrapbook of pictures of trees and/or pressed leaves and describe their products and benefits.

"Global Releaf" American Forestry Association
P.O. Box 2000
Washington DC 20013

Forest Types Found in U.S.A. and Its Territories

COOL CONIFEROUS FORESTS *(dark green on map)*

Cool Coniferous forests are found in high altitudes of the northern New England Appalachian Mountains and Alaska. The trees found in these areas include several species of spruce, along with pine, fir, hemlock, and northern white cedar, some red oak, birch, beech, and sugar maple.

TEMPERATE MIXED FORESTS *(light green on map)*

There are three types and zones of temperate mixed forests. The first type is the Broad-Leaf Deciduous, located in the eastern U.S. from the Atlantic Ocean to the Midwest. The trees included in this group are oaks, elm, beech, ash, maple, as well as some pine, fir, spruce, and hemlock.

The second type is the Needle-Leaf Evergreens and Deciduous. They are located in the Rocky Mountain forests, from Canada to Mexico. The ponderosa pine, englemann spruce, white fir, and larch are the trees found in this group.

The third type is the Warmer Moist Coniferous Forest, found on the west coast of the U.S. and Canada, from Alaska to northern California. Included in this group are the sequoia, douglas fir, sitka spruce, and western red cedar.

DRY FORESTS *(orange on map)*

Dry Forests are primarily located in southern California, southern Arizona, New Mexico, and parts of Texas. The types of trees found in these forests typically are the mesquite and chaparral.

WARM TEMPERATE MOIST FORESTS *(yellow on map)*

Warm Temperate Moist Forests can be found in the southeastern states. The trees most suitable to this climate include the longleaf pine, slash pine, shortleaf pine, loblolly pine, bald cypress, and many different species of hardwoods.

TROPICAL MOIST DECIDUOUS FORESTS *(purple on map)*

Located on the southern tip of Florida, in Hawaii, and Puerto Rico, the Tropical Moist Deciduous Forest includes the gumbo limbo, ipil, tamarinds, wild mahogany, and poisonwood.

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LESSON V – PLANT A TREE FOR GLOBAL RELEAF

Objective	Participate in planting and nurturing trees.
Focus	Action and individual effort
Outcome	The student will realize that he/she has a responsibility for creating and maintaining a life-supporting environment through a personal involvement with planting and nurturing a tree.
Background	Tree planting has been a part of many cultures, activities, and events dating back to the beginning of time. Trees are planted to remember loved ones and to celebrate life. In some eastern cultures people must plant trees to get married or divorced. In China, today, each person plants ten trees each year. Trees are the oldest and largest living things on earth. Bristlecone Pines found in the southwestern United States can be over 4000 years old and the Coast Redwoods in California grow to over 300 feet tall. Arbor Day is a tree planting ceremony celebrated all across America. Each state celebrates Arbor Day during the time when it is best to plant in its region. Arbor Day is the last Friday in April. Tree planting is an inexpensive way to help improve the health of our environment while we get pleasure watching a living thing grow. From a tiny seed grows a tree we can continue to enjoy. Trees can be continuously planted, harvested, and replanted providing benefits to man and the environment. The American Forestry Association estimates there are 100 million energy-saving tree planting spaces in American cities and towns that could be planted with trees to reduce energy costs, use CO_2, and help with the global warming problem.
Activities	Each student in the class should have the opportunity to plant a seedling either at home or at the school. Planting instructions are provided for each student.
Materials	Small digging tool Seedling (contact the local office of your state forestry agency or local nursery to get seedlings for your students) Planting instructions (attached) Water container
Procedure	Remind the students to bring a small digging tool and water container to class. As a class, discuss some reasons for planting trees. Hand out a set of planting instructions to each student. Designate an area of the school grounds to plant the tree seedlings. Demonstrate the proper method for planting a tree. Pass out the seedlings to the students and have them plant them six to eight feet apart. Have the students water their trees well. Follow planting instructions for follow-up care.

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Extensions

Have the students plot the weekly growth of their trees.

As a class, discuss various ceremonies or events and why they include the planting of trees.

Calculate the number of trees and/or tree spaces in a given space such as an acre, a block, or a neighborhood.

Visit an area you think could use some trees and get permission to plant one or more trees there.

Plan your school's Arbor Day celebrations. Include the singing of "*Pass These Gifts Along*" (included in kit).

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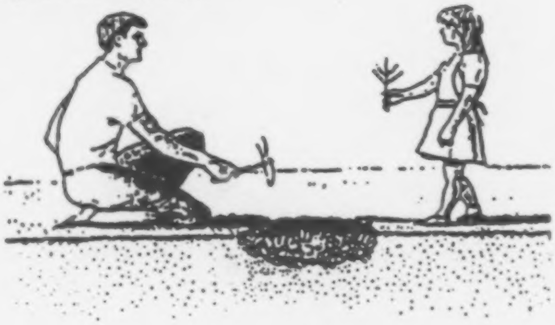
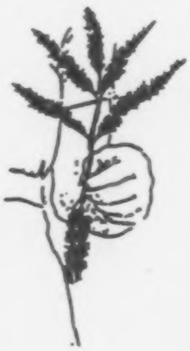
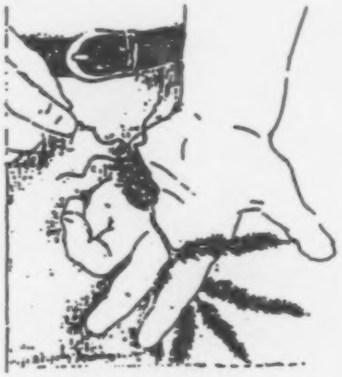
How to Plant Your Seedling

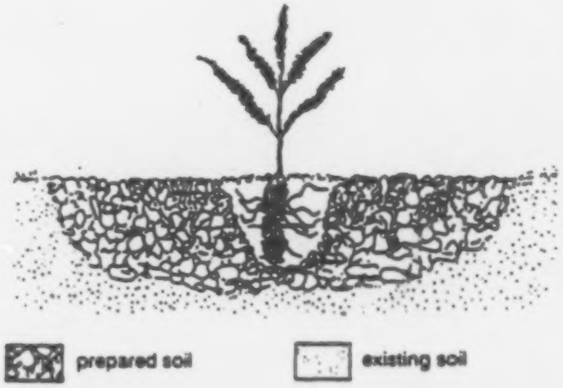
Make the tree you plant help in the global warming battle by planting it right. First select the best site for planting by targeting an area; choose a spot where the tree will supply valuable shade or wind control, and will not grow into surrounding utilities as it matures. Second, look for the best soil in that area (improving soil is a big job which is more difficult than just adding a little peat moss). Once the site is selected you are ready to plant.

1. Best tree growth is achieved by preparing an area rather than digging a hole or pit for planting.
2. Loosen the soil in an area about 18 inches in diameter and 6 inches deep.
3. Clear a spot in the middle of the loose soil, 2 or 3 times as wide as the tube or pot holding the roots.
4. Remove the seedling from the tube, pot, or bag.
5. Carefuly straighten roots that encircle the pot.
6. Place the roots on the soil before they start to dry.
7. Set the seedling at the proper planting depth by placing the root collar (where the seedling's stem meets the roots) at the level of the surrounding grade.
8. Spread loose roots and cover them with soil without kinking or bending them at sharp angles.
9. Lightly pack the soil around the roots with your hands.
10. Apply 2-3 inches of mulch (wood chips) to the entire area of loosened soil.
11. Protect the tree from foot traffic, weedeaters, and lawnmowers.









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Benefits Provided by Trees

ENVIRONMENTAL VALUES

- *Clean ground water* – The hair-like root fibers of trees help filter ground water, trapping nutrients and pollutants that could contaminate it.
- *Pollution control* – Tree leaves and roots act as natural filters of air and water (rain and ground), removing particulate matter.
- *Soil retention and rejuvenation* – Tree roots hold soil in place so it cannot easily be washed away by wind or water; also the decaying of dead tree parts adds nutrients back to soils.
- *Flood water control* – The root systems of trees hold in place soil that, if washed away by heavy rains, would flow into streams and rivers, making them shallower and allowing flood waters to overflow protective banks.
- *Mineral and nutrient cycling and retention* – Through growth, transpiration, and death, trees tie up minerals and nutrients from the air, water, and soil.
- *Climate control* – Trees work as natural barriers to wind, snow, rain, and solar rays to control climate in micro-areas.
- *Habitat for wildlife* – Trees and forests provide homes for many different species of animals.

HUMAN VALUES

- *Aesthetics (beauty)* – Trees beautify urban and community areas such as parks, streets, and schoolyards.
- *Health* – Trees provide green scenery that has been shown to speed up patient recovery in hospitals.
- *Physical health* – The forest is a great place to exercise; providing natural areas for such healthy activities like hiking and backpacking.
- *Recreation* – The forest provides many resources for activities like hunting, hiking, skiing, and bird watching.
- *Natural source of medicines* – Many parts of trees provide natural products that can be used in place of artificial substances in everyday household medications.
- *Education* – Forested areas offer many resources as outdoor classrooms.
- *Economy/jobs* – The forestry industry provides jobs for many, from loggers and sawmill workers to cabinet makers and home builders.

Types of Trees

- *Coniferous (commonly called Evergreens)* – are cone-bearing trees that have needles instead of leaves which they keep year-round; mostly soft wood, commonly used for building homes and furniture.
- *Deciduous* – are broad-leaved trees that shed their leaves in the fall and resprout them in the spring (with the exception of live oak, magnolias, and palms); some members of the deciduous species bear flowers, nuts, or fruit; mostly hardwood trees, commonly used in making floors, boats, fine furniture, and food products.

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TO SAVE A TREE

Social Studies, Values Discussion

Students will become aware of social, economic, legislative and emotional issues in resource conservation

MATERIALS NEEDED

"To Save a Tree" worksheet (one per student)

IMPLEMENTATION

Hand out student worksheets and tell them that you are going to discuss ways to save trees. Since trees are a renewable resource, discuss reasons why they need to be saved. You might mention the length of time it takes to grow a tree or the fact that a forest as large as the entire state of Rhode Island is needed to provide the paper products for a fast food restaurant chain for a single year. Ask students to rank the techniques for saving a tree according to which seem the most effective and desirable. This may be done as an individual or a small group activity. Allow sufficient time for students to evaluate and rearrange their choices.

Now, go through the choices with the class. Discuss and evaluate the tradeoffs involved in each technique. For example, using more plastics may create more hard-to-dispose-of waste and the manufacture of plastic uses non-renewable, petroleum-based chemicals. Writing threatening letters may be against the law and it uses more paper. More recycling of paper is good but might put a lumberjack or truck driver out of work. But then, more recycling means more jobs in recycling. Some of the jobs accomplished by spraying could be done by laborers but it would take longer and cost more money. The price of lumber could go up. Then, the price of products made from that lumber like furniture and houses could go up, too. Cotton diapers must be washed and sterilized – energy is used and soap and other washing products go down the drain. Packaging allows products to be kept on the shelf longer. It keeps products clean and separate from one another, but it contributes heavily to the amount of solid waste we must dispose of.

After this discussion, ask students to rank the techniques for saving a tree again. Have their choices changed? If so, why? What major issues remain unresolved? Remind students that there may not be one right answer to environmental issues. Often, there are positive and negative aspects to either side of any question.

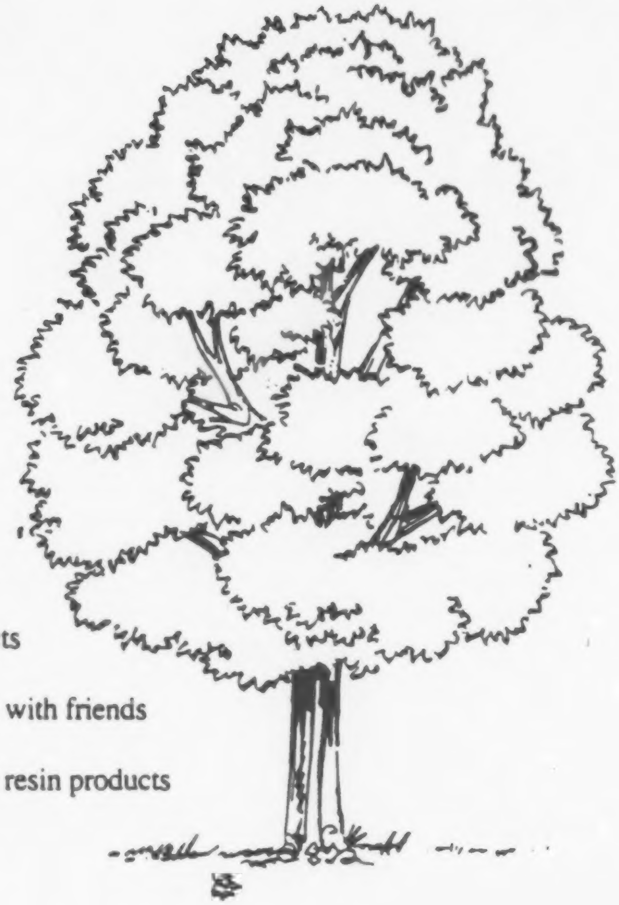
VOCABULARY

defoliant
fiber
logging
petroleum
resin
varnish

SOURCE

California Environmental Education Guide, Vol. 4

"Oscar's Options"
83 Park St
Providence, RI 02903



TO SAVE A TREE

Recycle paper

Recycle wood

Repair wood products that break

Refuse to buy or use wood products

Share your newspapers and books with friends

Don't use varnish and other wood resin products

Close down lumber companies

End defoliant spraying of forests

Close National Forests to logging

Create more National Parks

Start a letter writing campaign to "SAVE the TREES!"

Chain yourself to a tree

Use more plastic and less wood

Substitute cotton and other fiber products for wood (paper) products

Write threatening letters

"Oscar's Options"
83 Park St
Providence, RI 02903

Make Your Own Paper

Age: 5-12 years old

Goals: To show children that used paper can be recycled into new paper.

Background:

What happens to used paper? Most paper is thrown away in landfills or is burned. If we recycle paper we save landfill space and utilize valuable wood fibers over again.

Making your own paper from old paper is similar to what happens in a paper recycling mill. At a mill the pulp is put into a machine with a long moving screen. The water drips through the screen. Then the screen moves through parts of the machine that press and dry the pulp. The final product is new paper.

The paper you make will be much thicker and rougher than recycled paper made in a mill. Paper mills have many kinds of machines to make the paper smooth and flat.

If time is limited, most of the pulp can be prepared the night before. If you make it much in advance it should be refrigerated to prevent fermentation.

To make special occasion paper, add colored threads or dried flowers and leaves to the completed pulp.

Materials:

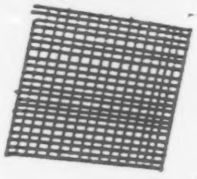
a blender or egg beater and bowl
a flat dish or pan, a little larger than the screen
a round jar or rolling pin
per child:
  10 pieces of tissue or newsprint
  a piece of non-rusting screen
  4 pieces of blotting paper or felt the size of the screen
  newspaper and blotting paper
  2 cups of hot water
  2 teaspoons of instant starch

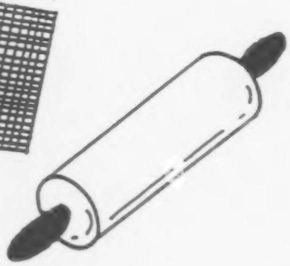
Procedure:

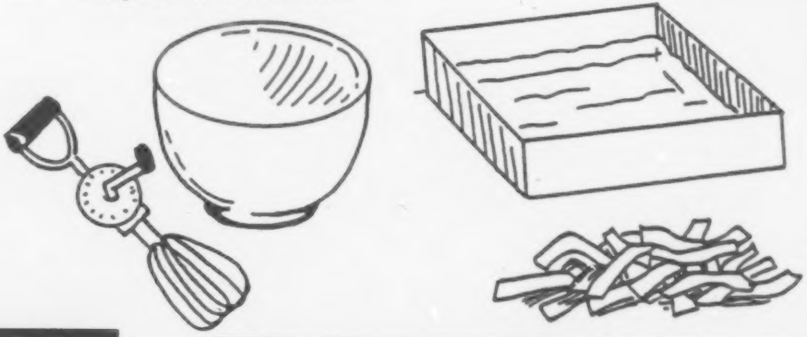
1. Tear the newspaper into very small bits. Add 2 cups of hot water to 1/2 cup of shredded paper.
2. Beat the paper and water in the blender, or with the egg beater, to make pulp. Mix in the starch. Completed pulp should be the consistency of split pea soup.
3. Pour the pulp into the flat pan.
4. Slide the screen into the bottom of the pan and move it around until it is evenly covered with pulp.
5. Lift the screen out carefully. Hold it level and let it drain for a minute.
6. Put the screen, pulp-side up, on a blotter on some newspaper. Put another blotter over the pulp, and more newspaper over that.
7. Roll a jar or rolling pin over the "sandwich" to squeeze out the rest of the water.
8. Take off the top newspaper. Turn the blotter sandwich over. Then take off the blotter and the screen very carefully. Do not move the pulp. Voila!! There is your paper!
9. Put a dry blotter on the pulp and let the paper dry for 24 hours.

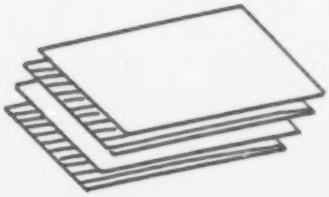
Going Beyond:

- Ask the children to speculate how much paper they use in one day (napkins, lunch bags, school work, paper cups, newspaper, etc.). What would life be like without all of these products?
- Encourage the children to use the paper they made in another art project.









"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Natural Dyes*

Age: 5-10 years old

Goal: To show children that natural products can be substituted for man-made products.

Background:

Many of the products that we purchase are colored or printed with man-made dyes and inks. Some of these dyes and inks have a petroleum base and quite a few of the brighter colors are derived from heavy metals like cadmium and lead. These elements move through food chains and accumulate in the tissues of higher organisms. Even trace amounts may impair body functions or cause death. Extraction of these harmful elements is difficult, and the remaining residues are toxic and persistent in our environment. As we become more concerned about our impact on the environment, we will be looking at natural dyes and inks for coloring and printing.

Materials:

chilled, hard-boiled eggs
containers for heating, storing and dyeing
dyes as indicated below:

Dye Base	Colors Produced
Walnut shells	Buff or adobe
Red cabbage leaves	Robin blue
Orange peels	Light yellow
Carrot tops	Smokey yellow/green
Fresh cranberries	Dark green
Onion skins	Orange
Spinach	Light gold

Procedure:

1. Prepare dyes ahead of time by placing a small amount of the items mentioned above in individual pans and add two cups of cold water. Place over heat and bring rapidly to a boil, simmer for 10 minutes, turn off heat, cover and steep for 30 minutes. Remove residues, place in containers and refrigerate.

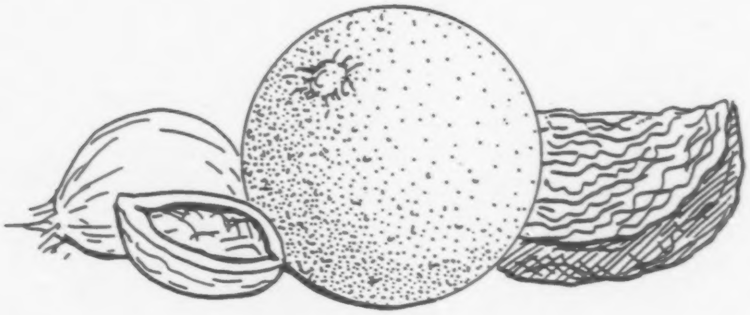
2. Discuss where colors come from with your class. Ask them if they know of any "sources" for colors. Discuss how things were colored in the past and what we might have used for inks. Explain to older students that many of our colors today are derived from heavy metals and the impact these metals have on the environment.

3. Show children the dyes that you made and their source materials. Ask them if they have any other ideas for natural dyes.

4. Assemble dyes, eggs and containers (recycled of course) and have children select dyes(s) for coloring their eggs. Coloring time varies with dyes and the intensity of color desired. Leaving the eggs in the dyes overnight will give the deepest colors. Remove from dye and dry on metal cake racks. Refrigerate eggs as soon as possible (refrigerated hard-boiled eggs can be kept for a week).

Going Beyond:

- Have children experiment with making other natural dyes.
- Use dyes for water coloring.
- Use dyes for tinting while making paper from recycled paper.



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PAPERMAKINGPAPERMAKINGPAPER

Science Activity

Students will create recycled paper and be able to explain the process of papermaking.

MATERIALS NEEDED

lots of newspapers, a variety of other paper goods, pieces of screen (old window screen), rolling pins, plastic sheeting (or an old shower curtain), blender, containers for water, large dishpans, several sponges

BACKGROUND

Between 1978 and 1980, Americans used 580 pounds of paper per person per year. Only about 27% of it was recycled. Recycling is important because it saves natural resources, reduces pollution and requires smaller amounts of energy. The manufacture of recycled paper requires 61% less water and produces 70% fewer pollutants than the manufacture of paper from virgin fibers. A 60% to 70% energy savings is also realized.

To produce one ton of paper packaging requires:
3,688 pounds of wood
216 pounds of lime
360 pounds of salt cake
76 pounds of soda ash
24,000 gallons of water
28 million BTUs of energy

Pollutants include:
84 pounds of air pollutants
36 pounds of water pollutants
176 pounds of solid wastes

IMPLEMENTATION

Begin activity by having students save various types of paper over the course of several days. Request that they bring in old newspapers for the project.

Share the following facts with your students:

- Paper constitutes at least 50% of the nation's municipal waste by volume.
- In an average high school, 85% of the wastes generated are either paper or paper products.
- The publication of the Sunday *New York Times* consumes 10,000 trees.
- Recycling a stack of newspapers three feet tall saves one tree.
- Recycling one ton of newspapers saves about 17 trees.
- Recycling one ton of newspapers conserves two to three cubic yards of landfill space.

"Oscar's Options"
83 Park St
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Inquire about any paper recycling projects with which your students may have been involved. Some communities have separated newspapers for years. Some homeowners routinely save newspaper for other uses. Many civic groups have been involved in "paper drives" to raise money.

Explain to students that, as more communities become active in Rhode Island's recycling program, more trees will be saved and landfill space will not be unnecessarily filled with this easily recycled commodity.

Tell students that recycled paper often becomes new paper and paperboard products, insulation, packing and cushioning materials and building products. Cereal boxes, paper toweling, toilet paper, cake mix boxes, shoe boxes, candy boxes and many of the other paper goods we use daily all contain recycled fibers. Assist children in following the steps to create their own recycled paper. Depending upon the availability of materials, this could be performed as a whole class or a small group activity.

Have students begin by tearing the used paper into tiny pieces. You may wish to have one group use only newspaper, one group mixed papers and another group only ditto paper for comparative purposes.

Place a handful of paper shreds and 2 cups of hot water into the blender. Mix until it has a watery-creamy consistency, which means the paper fibers have broken down. Repeat with successive batches being careful not to overload the blender.

Fill a dishpan with 4-6 inches of water and pour the paper "slurry" into the pan. Mix by hand. Dip the piece of screen (6 x 9 inches is a good, workable size - tape the edges to avoid small cuts from the wire) into the dishpan with one motion, then bring it up horizontally, lifting pulp up on the screen. Let water drip for a few seconds, tilt to drain, then turn (pulp side down) onto spread newspapers (plastic sheeting underneath will further protect your work surface). Place sponge against screen to soak up excess water. Squeeze water into slurry bucket and repeat until you've soaked up as much water as possible. Slowly remove screen. Flip recycled paper and newspaper onto more newspapers and pat dry or use rolling pin. SLOWLY AND CAREFULLY peel paper up and set in a warm place to dry (1-2 hours).

Options: add food coloring or bits of grass, leaves, dried flowers or other natural materials either directly to blender or into slurry. Also, pieces of colored construction paper will add visual interest to your finished paper.

If, at any step, the paper is unsatisfactory, just crumble it back into the dishpan of slurry and try again. Experiment with different colors and thicknesses. The younger your students, the thicker your slurry and paper should be, to allow for greater success. When the slurry is not producing thick enough paper, add more blended pulp.

"Oscar's Options"
83 Park St
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Explain to students that in the usual manufacturing process of recycling paper, machines perform all of the tasks the students did. Used paper is deposited in a pulper (a giant mixer continually filled with water, with a rotor in the middle and a sieve at the bottom). The rotor forces the water and paper to mix, breaking the paper into wood fibers. The fibers then go through a sieve and paper fibers are picked up from the water by heated cylinders which turn in a trough filled with paper stock. The cylinders deposit fibers onto a belt, matting them together until the desired thickness of paper is obtained. The wet sheets of paper pass over drying cylinders. The new paper will be off-white or have tiny colored fiber flakes. Virgin wood fibers can be combined with recycled paper fibers to make a higher quality paper.

Compare the students' recycled paper with other available papers in the classroom. Display pages of OSCAR's Options (printed from 100% recycled paper) for students to observe.

FOLLOW UP

"How Paper Is Recycled" can be completed as a homework assignment.

EXTENSION

Encourage students to recycle (save for collection) or reuse (both sides and scraps for art projects) all paper in the classroom.

Purchase 12 x 12 inch pieces of particle board, one per student. Paint one side with slate colored paint and supply students with chalk. Encourage them to use their slates instead of paper, whenever practical.

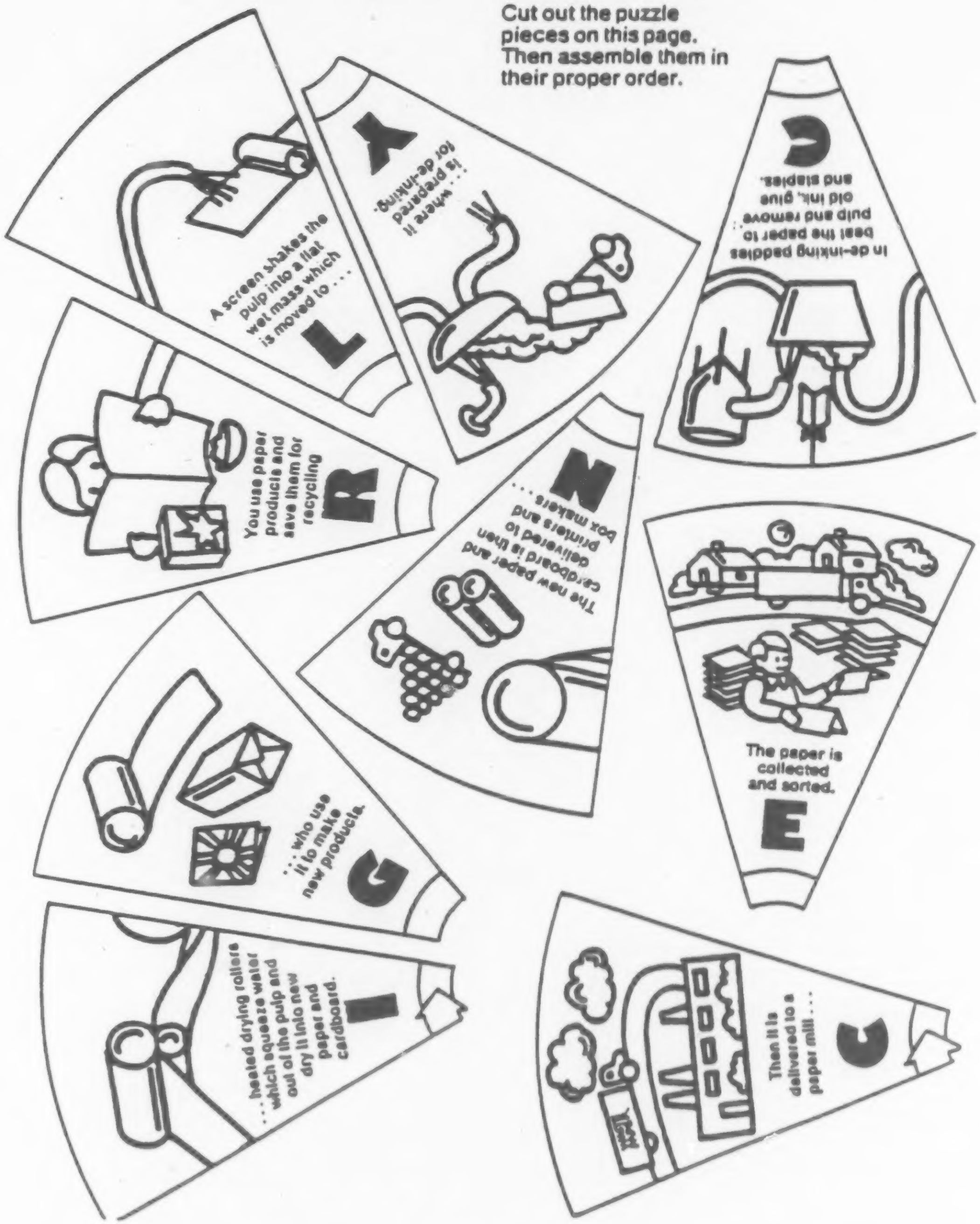
Help students to create a recycled paper cup in which they can plant a seedling. The cup can be planted in the ground where it will nourish the seedling as it decomposes. Follow the steps in papermaking, using two full pages of newspaper per planting cup. When pulp stage has been reached, have students mold the pulp inside a paper drinking cup. Instruct them to squeeze as much water as possible out of the pulp as they mold it. Allow it to dry totally – approximately three days. Upon drying, carefully peel off the original paper cup to reveal the fiber one. Plant seeds or a tree seedling in each cup, then place the cups in the ground. Allow students to observe and cultivate their plants noticing, over a period of time, the decomposition of the cups.

VOCABULARY

pulp
slurry
fiber

How paper is recycled

Cut out the puzzle pieces on this page. Then assemble them in their proper order.



A screen shakes the pulp into a flat wet mass which is moved to . . .

. . . where it is prepared for de-inking.

In de-inking paddles beat the paper to pulp and remove old ink, glue and staples.

You use paper products and save them for recycling

The new paper and cardboard is then delivered to printers and box makers . . .

The paper is collected and sorted.

. . . who use it to make new products.

. . . heated drying rollers which squeeze water out of the pulp and dry it into new paper and cardboard.

Then it is delivered to a paper mill . . .

"Oscar's Options"
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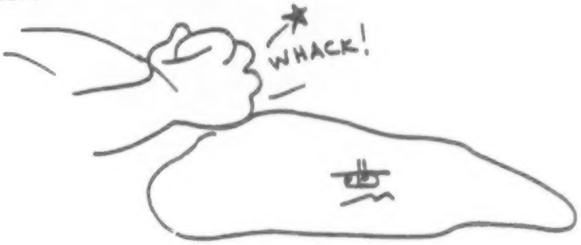
CERAMIC LEAVES

Materials needed:

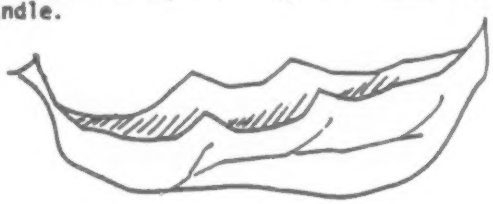
Ceramic clay
Large leaves, sycamore, maple or fruitless mulberry
Two strips of wood about ¼ in. thick
Rolling pin or dowel
newspaper or oil cloth
knife

Directions:

1. Pound clay to remove air bubbles.
2. Roll clay flat between two strips of wood. Make a slab large enough to fit leaf.



3. Remove stem from leaf. Place leaf, vein side down, on clay and roll with rolling pin or dowel to press into clay slab.
4. Use knife to cut outline of leaf. Leave about a 1½ inch strip to make stem.
5. Carefully remove leaf and bend edges of clay to resemble real leaf. Roll up stem to make a handle.



6. Let dry thoroughly. Fire in kiln.
7. Glaze, if desired. Fire again.

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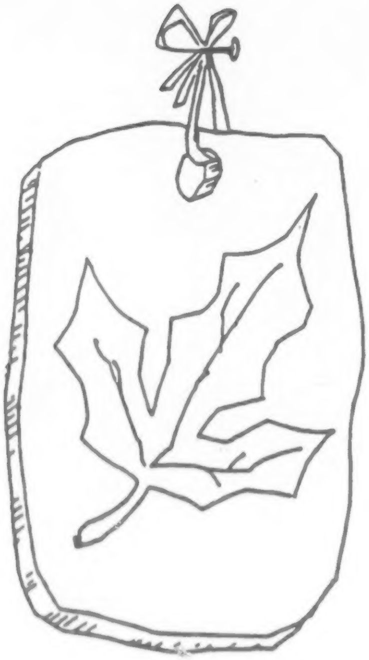

LEAF PRINT TILES

Materials:

- Ceramic clay
- Assortment of leaves
- Rolling pin or dowel
- Knife
- Two strips of wood, about ½ in. thick
- Newspaper or oil cloth

Directions:

1. Roll clay flat between two strips of wood.
2. Arrange leaf or leaves on clay slab, vein sides down.
3. Run the rolling pin over the leaves to press them into the clay.
4. Use knife to cut out tiles (or free form shapes).
5. Allow to dry for about a week. There is no need to remove leaves as they will dry and curl up. Pieces that may remain will burn away during firing.
6. When thoroughly dry, fire in kiln.
7. Glaze, if desired, and refire.

These tiles make good hot plates, spoon holders and can also be combined to make effective murals. You can even make a hole, while clay is wet, and hang them on the wall.

(Baker's dough can also be used to make these tiles. Recipe: 1 cup salt, 2 cups flour, 1/2 cup water, 2 tbsp. oil. Follow steps 1 through 4 above, then, bake in a slow 250 degree oven for several hours. The thicker the dough, the longer it will take to dry. After leaf has dried, it can be painted or coated with clear shellac.)

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St. Paul, MN 55108

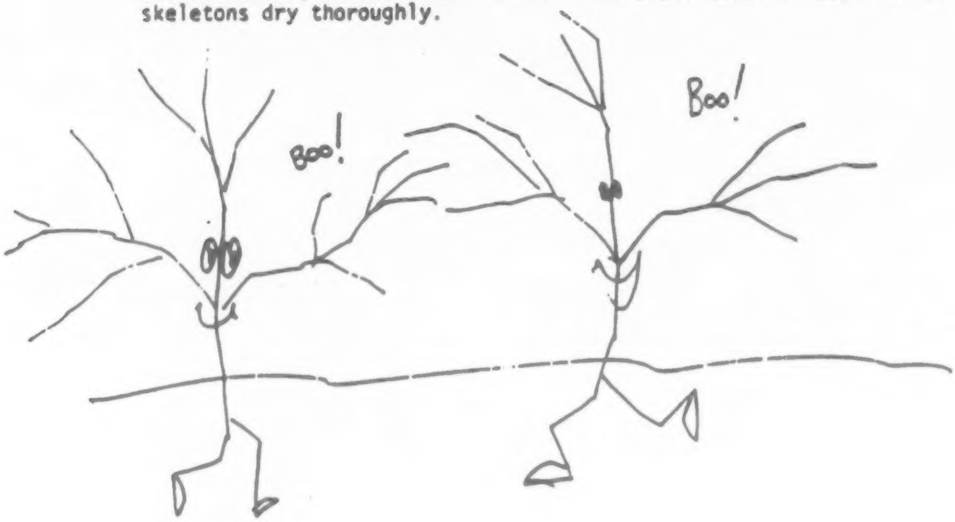
LEAF SKELETONS

Materials:

Large leaves (those that have heavy veins and texture work best)
Water
Sal soda (a cleaning agent available at the grocery store)
Soft toothbrush
Bleach
Food coloring
Large pot

Directions:

1. Put two quarts of water and two tablespoons of sal soda into large pot. Bring to a boil. Add leaves and cook for a half hour.
2. Let the water cool. Drain the leaves. Rinse with cold water and drain again.
3. Place the leaf on a work surface and with a soft toothbrush, gently brush away the leaf parts, leaving only the stalks and veins.
4. Bleach the leaf skeleton by placing it in a solution of two tablespoons of bleach to one quart of water. Leave leaves in solution for about an hour.
5. The leaves can now be tinted any color desired by placing them in water which has had food coloring added. When the leaves are the desired color, remove them and blot with paper towels. Let the leaf skeletons dry thoroughly.



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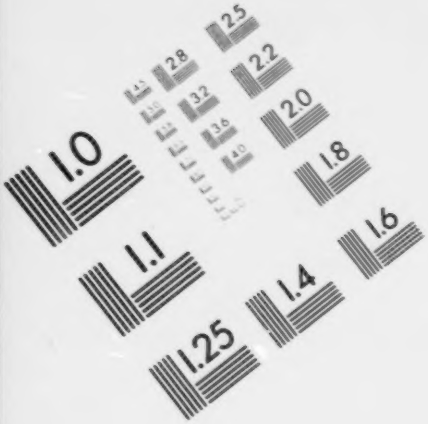

AIIM

Association for Information and Image Management

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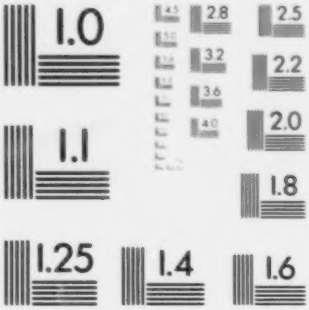

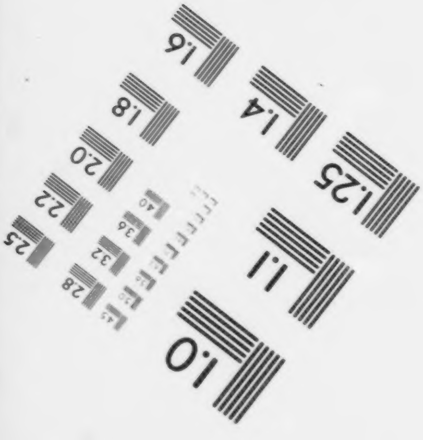

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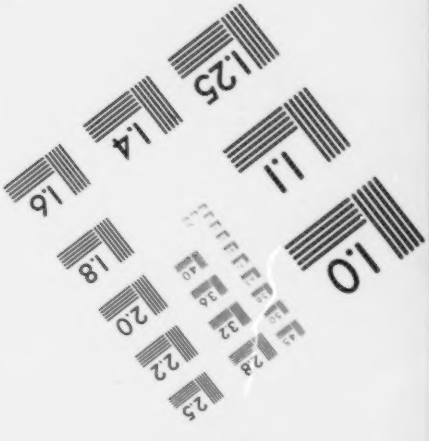

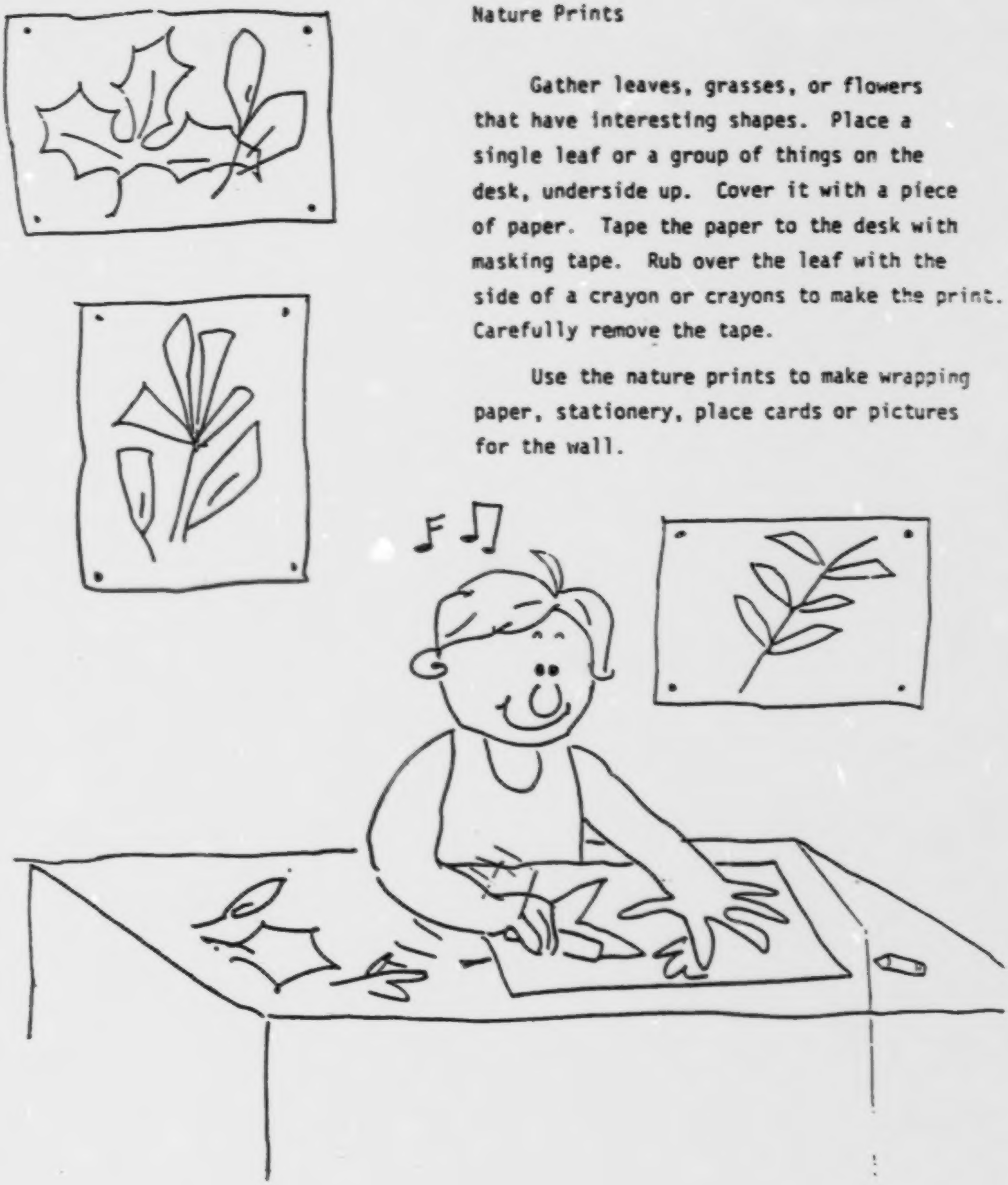

Nature Prints

Gather leaves, grasses, or flowers that have interesting shapes. Place a single leaf or a group of things on the desk, underside up. Cover it with a piece of paper. Tape the paper to the desk with masking tape. Rub over the leaf with the side of a crayon or crayons to make the print. Carefully remove the tape.

Use the nature prints to make wrapping paper, stationery, place cards or pictures for the wall.

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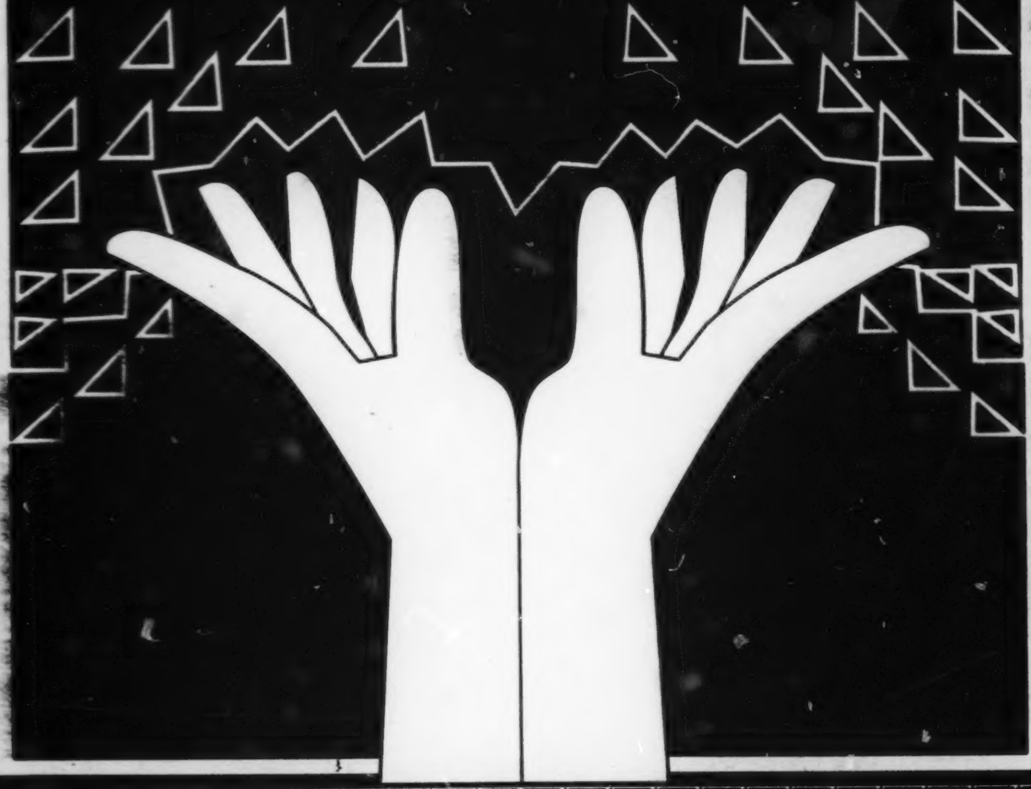
LEARNING ACTIVITIES

ECOSYSTEMS



ECOSYSTEM CONCEPTS

ENVIRONMENT

ECOSYSTEM

MATTER AND ENERGY

BIOSPHERE

HABITAT

NICHE

TROPHIC LEVELS

BIOTIC AND ABIOTIC

PHYSICAL FACTORS OF THE ENVIRONMENT

BIOTIC FACTORS OF THE ENVIRONMENT

ORGANIC AND INORGANIC

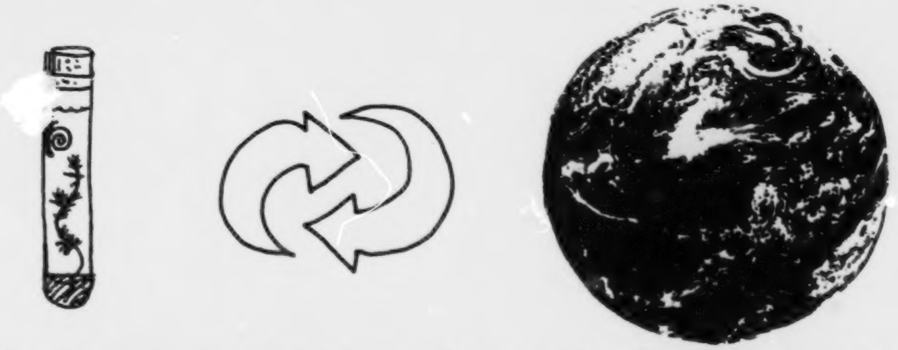
PRODUCERS, CONSUMERS AND DECOMPOSERS

SYMBIOSIS

PRIMER ON THE ECOSYSTEM

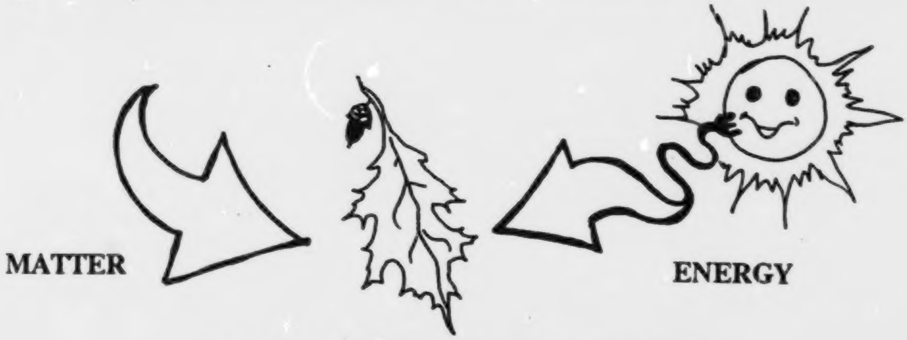
By Kay T. Dodge, Ph.D.

The **ecosystem** is the basic functional unit of the **environment**. The environment, which is everything that surrounds us, is made up of ecosystems, which are living and non-living things interacting to produce a cyclic exchange of **matter** and **energy**. Within any ecosystem, whether it be as small and simple as a test tube with a plant and a snail or as large and complex as the earth's **biosphere**, there is a dynamic flow of matter and energy.



Matter within an ecosystem is used over and over again. The same atoms of carbon, hydrogen, nitrogen, and oxygen have been used for millions of years in constructing life forms. Nature is the great recycler of matter, the raw material of life.

Energy on the other hand must constantly be replaced in the ecosystem. As energy passes from one **trophic level** to another in an ecosystem. It is used, stored, or converted to heat. Unlike matter which can be recycled, energy must constantly be replaced to keep the system operating. The sun is the source of most of the energy in ecosystems, and green plants provide the vital link making energy usable in life systems.



PLANTS ALLOW US TO "PLUG" INTO
THE SUN'S ENERGY

All ecosystems contain **abiotic** (non-living) and **biotic** (living) components. The abiotic world consists of inorganic things like water, air, minerals, nutrients, for example, the non-living part of soil. Also included in the abiotic world are the **physical factors** of the environment such as climate, light and temperature, pH and others.

The biotic or living world consists of **producers** and **consumers**. Most producers are green plants which through the process of photosynthesis, are able to capture the sun's energy in a form usable in life systems.

SITE OF PHOTOSYNTHESIS: CHLOROPLASTS WITH CHLOROPHYLL

RAW MATERIALS + ENERGY → CAPTURED ENERGY + WASTES

$$CO_2 + H_2O + \rightarrow C_6H_{12}O_6 + O_2 + H_2O$$

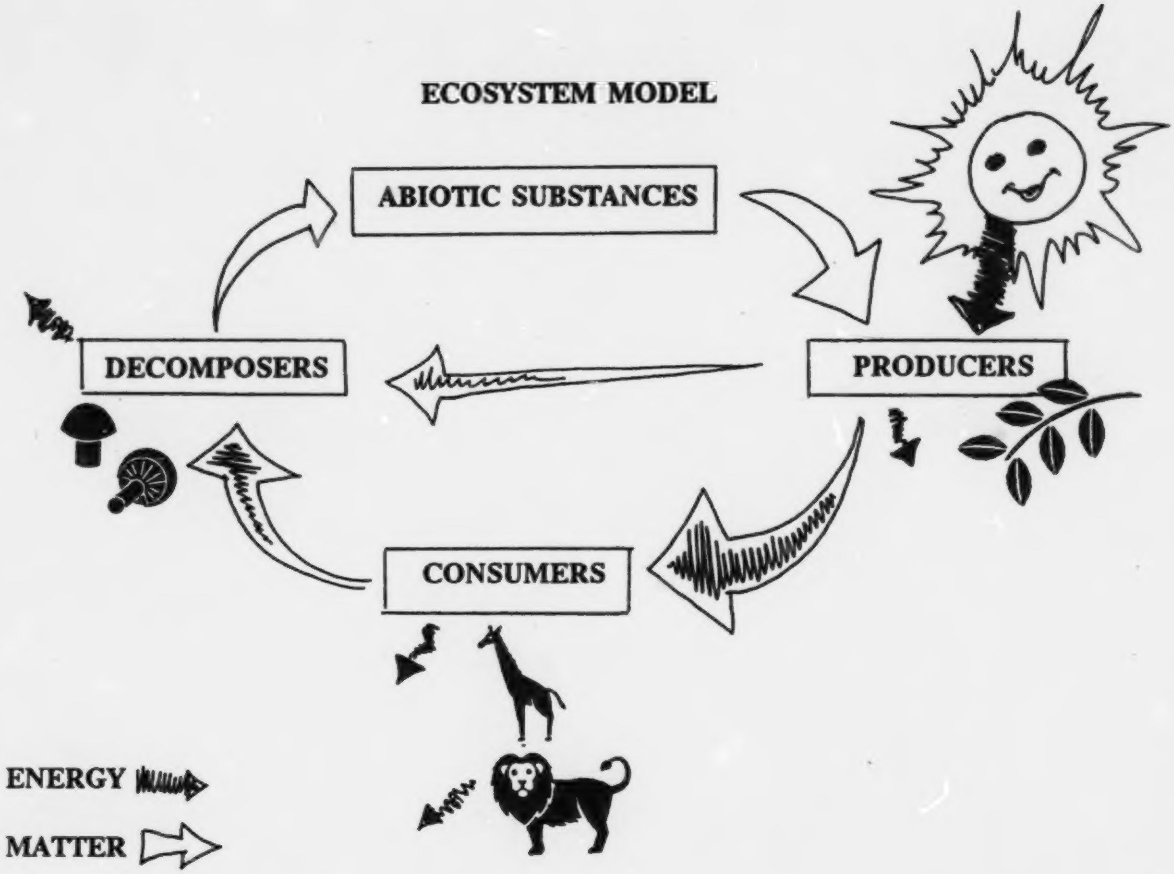
Carbon Dioxide + Water + Sunlight→ yields→ Sugar + Oxygen + Water

Within the bonds of the **organic** sugar molecule energy is stored and can later be converted into other molecules used for growth or reproduction or stored for later use.

Within the ecosystem are many different types of consumers which form food chains passing energy and matter from one trophic level to another.

NAME	FUNCTION	EXAMPLE
Herbivore:	plant eater	cow
Carnivore:	animal eater	wolf
Omnivore:	eats both plants and animals	man
Parasite:	lives off a living host	lamprey
Saprophyte:	plant that lives off dead organic material	mushroom
Scavenger:	animal that lives off dead organic material	hyena
Decomposer:	breaks down organic matter to inorganic matter	bacteria

ECOSYSTEM MODEL



Ecosystems:

There are many types of ecosystems found on earth: land ecosystems including tundra, forests, grasslands and deserts, as well as both fresh and salt water marine ecosystems. No matter how large or small they each contain the basic ecosystem components. Matter cycles within the system while energy must constantly be renewed. Because of the interactive nature of all ecosystems, matter can travel great distances, but it remains within the biosphere.

We are just beginning to understand how the compartments of air, water and land are linked in a fragile global ecosystem. The impact of the activities of one species, man, is having a profound effect on the earth's life-support system. We must understand how we are all connected and how we all can act to protect our shared global ecosystem.

LEARNING ACTIVITY: Welcome to Ecoville!

OBJECTIVES: Enhance understanding of the components in an ecosystem and their interrelationship; classification of living and non-living things according to their part in the ecosystem, including: energy; abiotic (non-living) components; producers; consumers; and, decomposers.

AGES: Second through Fifth Grades

DESCRIPTION: Students design an ecosystem "tour" using pictures that represent each component of the ecosystem. Designed by Deborah Meadows.

MATERIALS: Old Magazines
Craft "Popsicle" Sticks (or Tongue Depressors)
Clear Contact Paper
Scissors
Construction Paper or Notecards

PREPARATION: Go through old magazines to find and cut out various pictures representing the following:

- Energy - Sun only, since all of Earth's ecosystems are fueled by energy from the sun
- Producers - Organisms that use the sun's energy to manufacture their own food
- Consumers - Organisms that eat or depend on producers for their food
- Decomposers - Organisms that break down consumers/producers
- Abiotic Components - Non-living parts of the ecosystem

Make sure you have at least one picture in each category for the individual student or team of students. Place the cut-outs face down onto pieces of clear contact paper, cut roughly the same size as the pictures. Depending on students' abilities, they can prepare construction paper or notecard backings for the picture, with the name or function of the particular part of the ecosystem. Lay a craft stick onto the back of the picture (or between picture and backing) and cover with another piece of contact paper, attaching sticky side to sticky side. Cut around the "sandwiched" picture. The pictures will end up as "lollipops" on the end of the craft sticks. Variations: for a special addition, a bright yellow bow can be put on the energy stick.

After reviewing the ecosystem parts with students, have them design their own, complete ecosystem by selecting various pictures representing the five parts.

STUDENT DIRECTIONS:

1. Have students name their ecosystem. They can make their own welcome sign on construction paper and then "sandwich" it between sheets of clear contact paper.
2. Remind students that all of Earth's ecosystems are fueled by the sun's energy.
3. Have students select the parts of their ecosystem from picture piles set out conveniently in the classroom. (For younger students, you may want to separate pictures into piles and label the piles with the specific part of the ecosystem.)
4. As time allows, have students take turns leading others through their "designer" ecosystem. Make sure their tour includes an explanation of how different components relate to each other, e.g. producers make their own food from the sun's energy. Consumers eat producers or other consumers.

TREE AMIGOS ACTIVITY

LEARNING ACTIVITY: Stream Survey - Part I: Measuring velocity and flow.

OBJECTIVES: To make field measurementsan and calculations then apply them to mathematical formulas.

AGES: Sixth through Adult

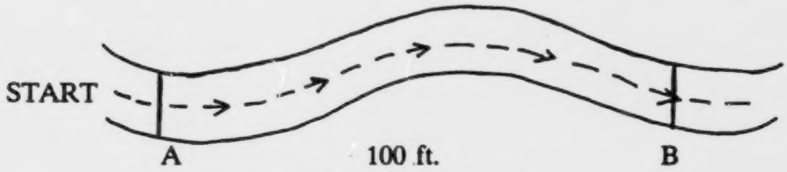
MATERIALS: *Clipboard - paper and pen*
Tape Measure (string measure will do)
Yard Stick
Watch with second hand
Floats (use sticks or twigs)
Calculator (not necessary but makes the math go faster)

DESCRIPTION: How much water actually flows through a stream? The measurement of velocity and volume of flow of a stream can be determined by using the following simple steps. Designed by Kay T. Dodge, Ph.D.

I. MEASURING VELOCITY:

1. Locate and mark two points 100 ft. apart or any convenient distance over 50 ft.
   HINT! Position three people, one to drop a float and two to act as timers at the beginning and ending point.

2. Record the time it takes a float to drift between the two points. HINT! Let the stick flow with the current several feet before timing begins. Repeat four times and average the various times.



3. Compute the number of feet traveled per second by dividing the time in seconds into the distance. Example: time 20 seconds divided by distance/ 100 ft = 5 ft. per second

HINT! Everything must be in feet and seconds. 6 inches = .5 feet 1 minute 10 seconds = 70 seconds

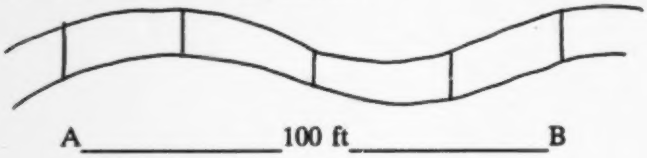
II. MEASURING VOLUME OR RATE OF FLOW

Formula: $$R = \frac{W D a L}{T}$$

Don't Panic it's Easy!

R = Rate of Flow in cubic feet per second
W = Average width of a stream in feet

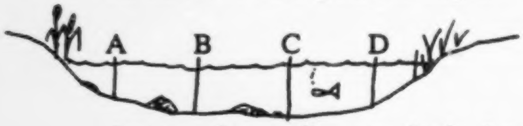
HINT! Measure the width in several places along your measured stretch of stream. The more variation the more measurements!



It helps to have one person hold the tape on the other side of the stream and the other person take the measurements and record them. Average the measurements to get the average width.

D = Average depth in feet

Measure the depth in several areas with a yard stick. The bottom may vary a great deal on bends or near pools or edges.



Average the readings to obtain Average Depth.

a = Constant factor for bottom type
Smooth sand = .9 (10% drag)
Rough rocks = .8 (20% drag)

This is a correction for the drag factor. The friction from the bottom and banks cause the water to flow slower in these areas. If you have half sand and rocks use .85.

L = Length of stream measured.

Keep the distance in round numbers if you can. It makes the math easier.

T = Time in seconds for a float to travel the distance.

Use natural objects only and drop them in the middle of the stream. Bridges are good starting points for larger streams.

III. SAMPLE STREAM

Let's try a sample stream which has the following information:

Width = 25 feet
Depth = 2 feet 6 inches (remember seconds and feet only)
Bottom = Rocky
Length = 100 feet
Time = 40 seconds

$$R = \frac{W \times D \times a \times L}{T} \quad \text{or} \quad \frac{25 \times 2.5 \times .8 \times 100}{40}$$

R = ____________c.f.s.

Once we have rate of flow in cubic feet per second (c.f.s) we can multiply this number to determine the following:

1 c.f.s. = 7.48 gallons per second
1 c.f.s. = 646,317 gallons per day
1 c.f.s. = 86,400 cubic feet per day
1 c.f.s. = 2 acre feet per day
1 acre foot = 43,560 cubic feet or 325,850 gallons
1 cubic foot of water = 7.48 gallons and weighs 62.4 lbs.

R x 86,400 = cubic feet per day x 62.4 lbs per day.

HINT! c.f.s. = second foot, the universal measurement of water quantity.

* The numbers will be very large so calculators do help.

AQUATIC COMMUNITIES DATA SHEET:

By ____________________
Date ____________________
Name of Stream ____________
Location ______________
County ____________________

AVERAGE WIDTH:
AVERAGE DEPTH:

Bottom: ________ __________
Velocity: _____ Sec _____ Ft _____
c.f.s: __________ Gal/sec ______
gal/day ____________________

AIR TEMP:
WATER TEMP:

Color:
Turbidity:

WATER TESTING:
Dissolved oxygen -
Free acidity -
Alkalinity -
Hardness -

pH -
Nitrate -
Phosphate -
Other -

DESCRIPTION OF THE WATERSHED:

POSSIBLE POLLUTION AND ITS SOURCE:

FLORA AND FAUNA OBSERVED AND IDENTIFIED:

PLANTS	ANIMALS
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
11.	11.
12.	12.
13.	13.
14.	14.
15.	15.

FOREST IN A JAR

Objectives

Students will be able to: 1) observe and describe succession; and 2) summarize what they have learned about how environments can change.

Method

Students conduct an experiment using soil, water, seeds, a plant, and a jar; and then draw a poster to represent their observations and findings.

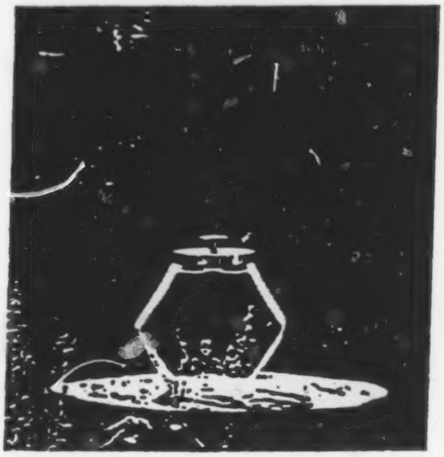
Background

Succession is a term used to describe the ever-changing environment and the gradual process by which one habitat is replaced by another. Many habitats that appear to be stable are changing before us. In this activity, students will be able to see in miniature how a swampy area can be succeeded by a forested habitat.

The major purpose of this activity is for students to recognize the process of succession.

Materials

pint or quart jars (one per student or small groups of students, or one for the entire class), water, soil, aquatic plants (one per jar), two cups bird seed



Procedure

1. Place two inches of soil and three inches of water in a jar. Place the jar at a window, without a lid, and allow it to settle overnight.
2. Plant an aquatic plant in the jar. It should grow well in this environment. If your classroom has no windows, substitute a grow-light.
3. Do not replace the water that evaporates from the jar.
4. Once or twice a week, have students add three or four bird seeds to the jar. While there is water in the jar, the seeds should germinate and then rot. Continue adding seeds even after the water evaporates.
5. As the water evaporates down to the soil, the aquatic plant will die. The bird seeds will now find the environment suitable for successful growth. Sunflower seeds, which grow large, can be added to represent forest trees. You will now need to add water, as a substitute for rainfall, to keep the soil damp to keep things growing.
6. Have each student make a poster, drawing, or other visual representation of what they saw happen to their "pond." Ask them to talk about what they have learned about how environments can change. Introduce the term, "succession," to older students.
7. OPTIONAL: Take a field trip to a pond. What plants are growing in the water? What plants are growing on the shore? What parallels are there between this real pond and the "pond" in the jar? Make a second drawing of this real pond. Compare the similarities and differences between the two.

NOTE: See "Pond Succession," and use it as an extension to this activity.

Age: Grades K—6
Subject: Science
Skills: analysis, application, comparing similarities and differences, description, discussion, drawing, generalization, invention, media construction, psychomotor development, research
Duration: five to ten minutes for one or two days a week for several weeks; 20 to 30 minutes for summary activity
Group Size: any
Setting: indoors; outdoors optional
Conceptual Framework Reference: III.A., III.A.1., III.A.3., III.B., III.C., III.C.1., III.C.3., III.C.4.
Key Vocabulary: evaporation, change, succession

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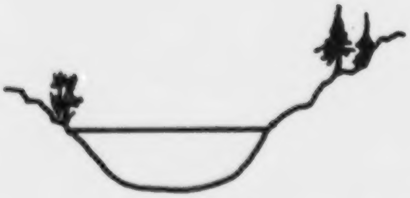
Evaluation

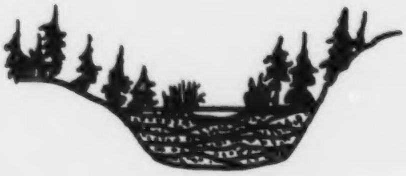
Describe three changes you saw happen to what was inside the jar.

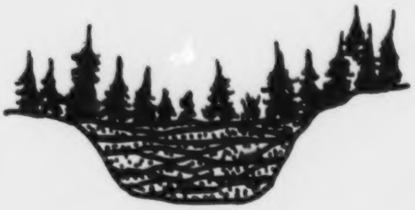
Number these drawings to show their order from what would be most likely to be first, to what would be likely to last.

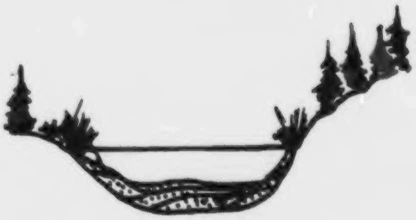
Draw lines from each of these animal names to the places above where they would be most likely to live.

fish turtle raccoon squirrel deer









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CYCLE, RECYCLE
Introduction

Students will be introduced to the concept of cycles and observe four of nature's cycles.

MATERIALS NEEDED
"Cycle, Recycle" worksheet (one per student)

IMPLEMENTATION
Explain to students that a cycle is a series of events which reoccur regularly, usually leading back to the starting point. Plant and animal life depend on nature's continuous cycles.

Distribute worksheets to students, discuss the various cycles and instruct students to illustrate the steps involved in each cycle.

Explain that people can imitate nature by giving new life to materials that do not break down in the waste stream. Several products regularly found in solid waste from school and home can be recycled. That means they can be broken down, reprocessed and returned to active use rather than being discarded to take up space in the landfill or to contribute to our ever-present litter problems. Recycling benefits all of us by reducing the amount of solid waste, conserving energy, creating jobs and preserving our resources. Throughout this unit, students will become familiar with the materials which can easily be recycled and the methods by which they are reprocessed.

VOCABULARY
nutrients
decay
photosynthesis
evaporate
cycle
sediment
erode
minerals

TREE AMIGOS

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Providence, RI 02903

CYCLE, RECYCLE

Illustrate each cycle.

NUTRIENT CYCLE

All living things need food, or nutrients, to grow. Plants take up nutrients from soil to make sugar. Animals then eat the plants. They return nutrients to the soil through body wastes. When plants and animals die and decay, nutrients are returned to the soil.

OXYGEN CYCLE

Plants give off oxygen as a waste product of photosynthesis. Animals take in oxygen as they breathe. They exhale carbon dioxide (CO_2). Plants use the carbon dioxide for photosynthesis.

WATER CYCLE

The sun evaporates water from rivers, oceans and lakes. Water vapor forms clouds when it cools. Clouds release water as rain. Water soaks into the ground for plants and animals to use. Water not used runs back into the lakes and oceans.

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Providence, RI 02903

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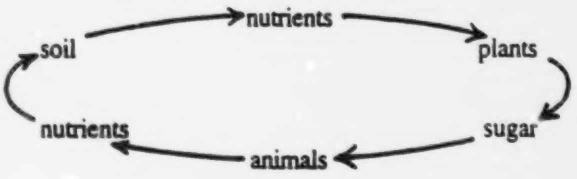
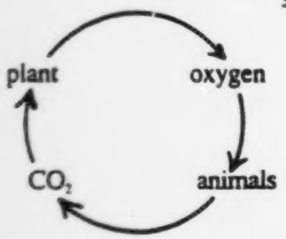

nutrients
soil
plants
nutrients
sugar
animals

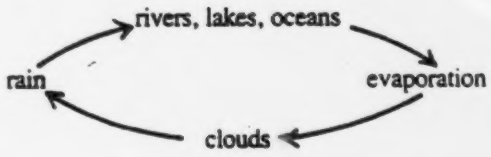
OXYGEN CYCLE


plant
oxygen
CO_2
animals

Plants give off oxygen as a waste product of photosynthesis. Animals take in oxygen as they breathe. They exhale carbon dioxide. Plants use the carbon dioxide for photosynthesis.

WATER CYCLE

The sun evaporates water from oceans and lakes. Water vapor forms clouds when it cools. Clouds release water as rain. Water soaks into the ground for plants and animals to use. Water not used runs back into the lakes and oceans.


rivers, lakes, oceans
rain
evaporation
clouds

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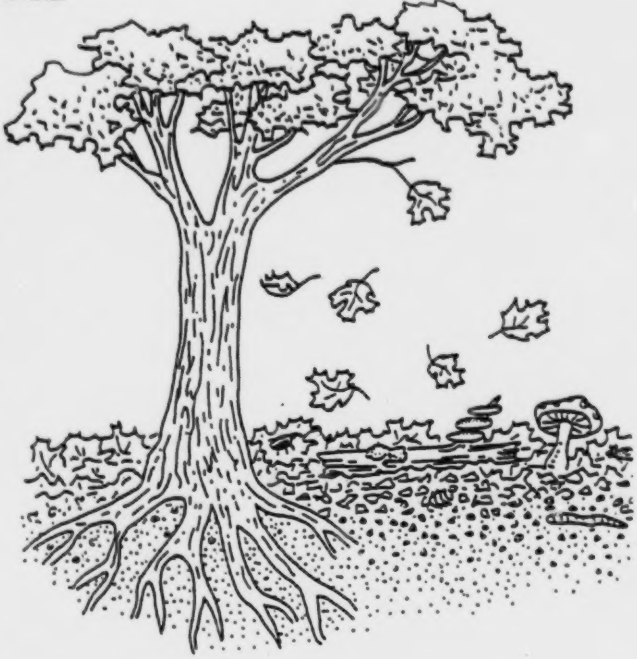
Nutritious Litter

Humans use trash cans for their garbage. What about nature? Does nature really *need* garbage cans? Nature's waste doesn't go into garbage cans because nature **recycles** its litter!

Nature's wastes are made up of dead animals and plants. Think about fallen leaves. Over time, leaves go through many stages. They begin as tiny buds. Next, using **nutrients** from the soil, leaves grow. They store important nutrients for the tree. When autumn comes, leaves fall to the ground.

Luckily the nutrients in fallen leaves are not lost forever. **Decomposers**, little animals and plants, slowly break down fallen leaves into nutrient rich soil. The tree will use the nutrients from the soil again to make new leaves.

Nature has no garbage cans because all wastes are used over and over again.



Activity #3 Leaf Litter

Find a place in the park with many trees. Look for **leaf litter**, which is layers of dead leaves on the ground. You will see the nutrient cycle in action! (Please read the information about poison ivy on the inside front cover of the booklet.)

1. Look up at the leaves that are still on the trees. What do they look like?

What color are they? ____________________

Are they moist or dry? ____________________

Do they bend easily? ____________________

Do they break easily? ____________________

2. Kneel down in the leaves that are underneath your feet. How are these leaves different from the living ones?

What color are they? ____________________

Are they moist or dry? ____________________

Do they bend easily? ____________________

Do they break easily? ____________________

3. Dig your fingers through the layers of leaves. Each year another layer of leaves is added to the forest floor. If it weren't for **decomposers**, the forest's leaf litter would be miles high!

How many inches deep is the leaf litter? ________

What does the leaf litter smell like? ____________

4. Find a leaf that looks like it has just fallen. Sketch it in the top box on page 9.

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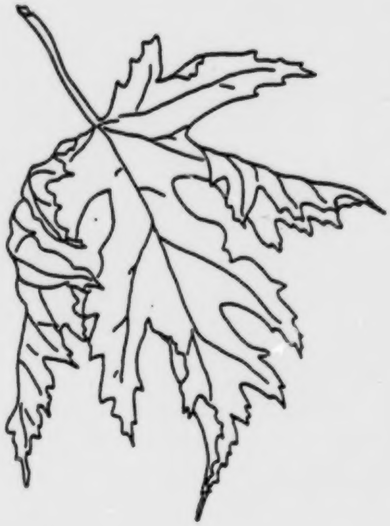
New Fallen Leaf

Old Fallen Leaf



Now pull a leaf from the bottom of the leaf litter. Sketch it in this box.

How can you tell the decomposers have been working? Have some parts of the leaf already been turned into soil? If so, which parts? How is this leaf similar to a skeleton?

5. What would happen if leaf litter did not rot?

Why is it important for leaf litter to rot?

Leaf litter contains the nutrients that plants need to grow. If nature's litter did not decompose, the dead leaves would pile up higher and higher. Important nutrients would not be returned to the soil. Plants could not grow. Nature's cycle would be broken.

Do you recycle any of your garbage? Your cans and bottles are really part of nature's nutrient cycle. By recycling them you can keep the cycle going.

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LESSON II – LIVING IN A "HOT HOUSE"

Objective Debate global warming and illustrate the possible greenhouse effects.

Focus Understanding of atmospheric gases and temperature.

Outcome The student can define global warming and how the greenhouse effect works and draw a diagram illustrating the greenhouse effect.

Background It is now recognized and accepted that, because of human activities such as world energy production, industrialization, and tropical deforestation, conditions are being created that are warming up our planet. This global warming is a result of a process called the "greenhouse effect."

What is the greenhouse effect and how does it work?

Benefits of the Greenhouse Effect

Man-caused activities and naturally occurring processes emit gases into the atmosphere. These gases act like the glass in in a greenhouse, allowing the shorter wave, ultraviolet rays of the sun in but trapping the long waves of infrared radiation and reflecting them back to earth. The result is an envelope of "greenhouse gases" being formed around the earth trapping heat and warming the planet's lower atmosphere.

What are these greenhouse gases and where do they come from?

About 80% of these gases come from the burning of fossil fuel, which releases carbon dioxide (CO_2) into the atmosphere. Other gases including nitrous oxide (N_2O), methane (CH_4), chlorofluorocarbons (CFCs), and ozone (O_3) also contribute to the global warming problem. They are expected to contribute just as much to global warming as CO_2 by the year 2010.

Man has substantially increased the release of greenhouse gases through energy production, industrialization, biomass burning, and deforestation. In nature, lightning, naturally occurring fires, volcanic action, the weathering of certain bedrock, and the bacterial decomposition of organic matter give off greenhouse gases.

Carbon dioxide emissions are principally a by-product of fossil-fuel burning. However, deforestation accounts for about a quarter of the current CO_2 levels.

Nitrous oxide is another greenhouse gas that is rapidly increasing in the atmosphere. This gas is released by burning fossil fuels including gasoline, oil and coal.

Methane is produced primarily through the bacterial decomposition of organic matter – particularly in places like landfills, swamps, and the digestive systems of animals. However, biomass burning, fossil-fuel production, and organisms in the ocean emit methane, too.

Chlorofluorocarbons (CFCs) are man-made compounds used as refrigerants, cleaning solvents, and raw materials for making plastic foam.

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Ozone forms a beneficial shield against the sun's ultraviolet rays at high altitudes (stratosphere). At lower altitudes it becomes less positive by serving as a heat-trapping greenhouse gas. It, too, is a by-product of the burning of fossil-fuel. Lightning forms ozone naturally by splitting oxygen molecules and allowing these oxygen atoms to combine with other oxygen molecules.

Activities

Discuss, as a class, the types of gases which make up our atmosphere. Make a list of the more common gases and the activities or events that form them (see list in Appendix A). Discuss, as a class, the concept of global warming and the greenhouse effect. Have the class illustrate the greenhouse effect.

Materials

Blackboard and chalk
Copies of unlabeled greenhouse effect diagram for each student (Master attached)
Paper and pencil
Magazines, newspapers

Procedures

Ask the students to name various common gases that make up the air we breathe. Have the students name and list the man-made activities or natural processes that form these gases. Newspapers, magazines, and other materials from the media center or classroom library may be provided as resources to generate the list. Ask the students what the greenhouse effect is and how it works. On the blackboard or with an overhead projector illustrate the greenhouse effect.

Distribute copies of the unlabeled diagram of the greenhouse effect and have the students label its component parts.

Extensions

Make a class model of the greenhouse effect using pictures of activities or events forming greenhouse gases.

Illustrate the concept of global warming by using an aquarium, thermometers, and light source.

Develop a bulletin board to show the names and symbols of gases and the natural processes or man-made activities that form the gas. Pictures found in magazines or newspapers may be used.

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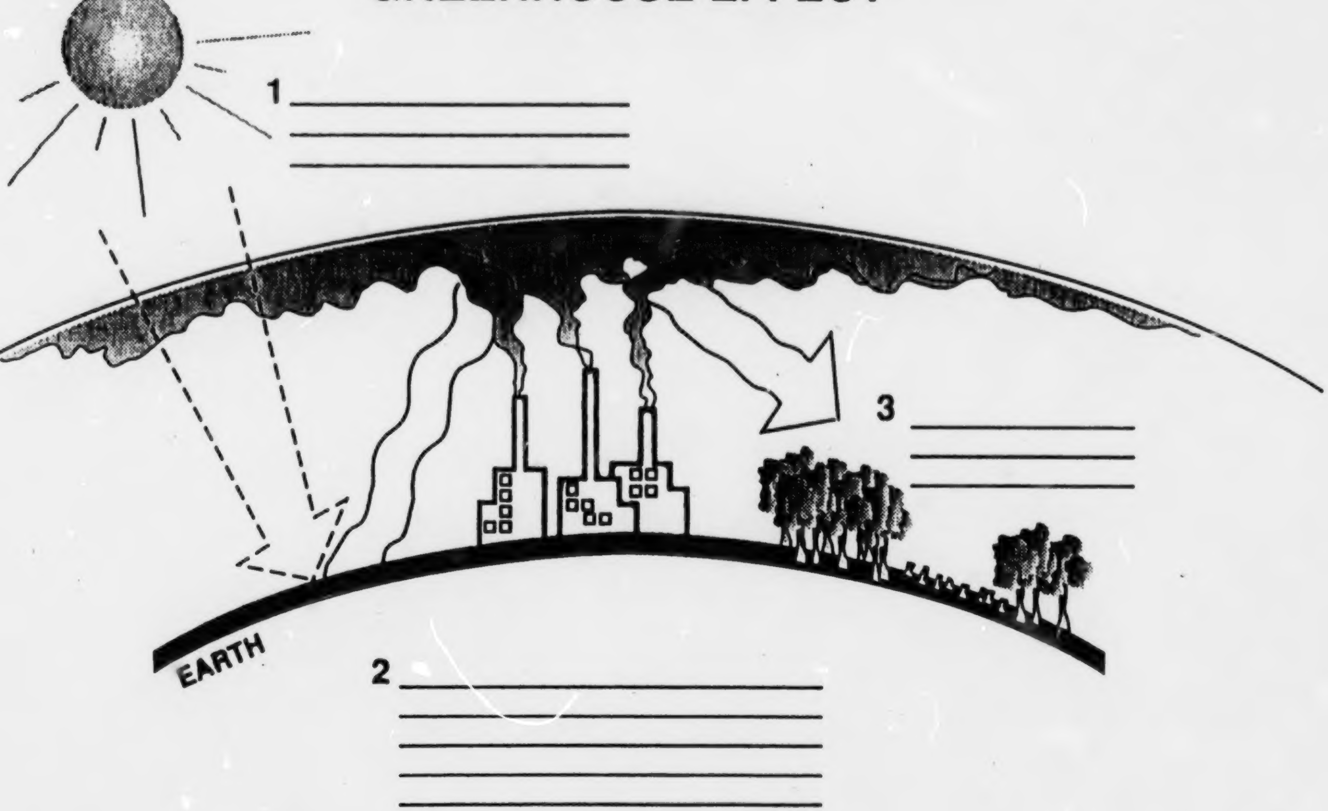
GREENHOUSE EFFECT



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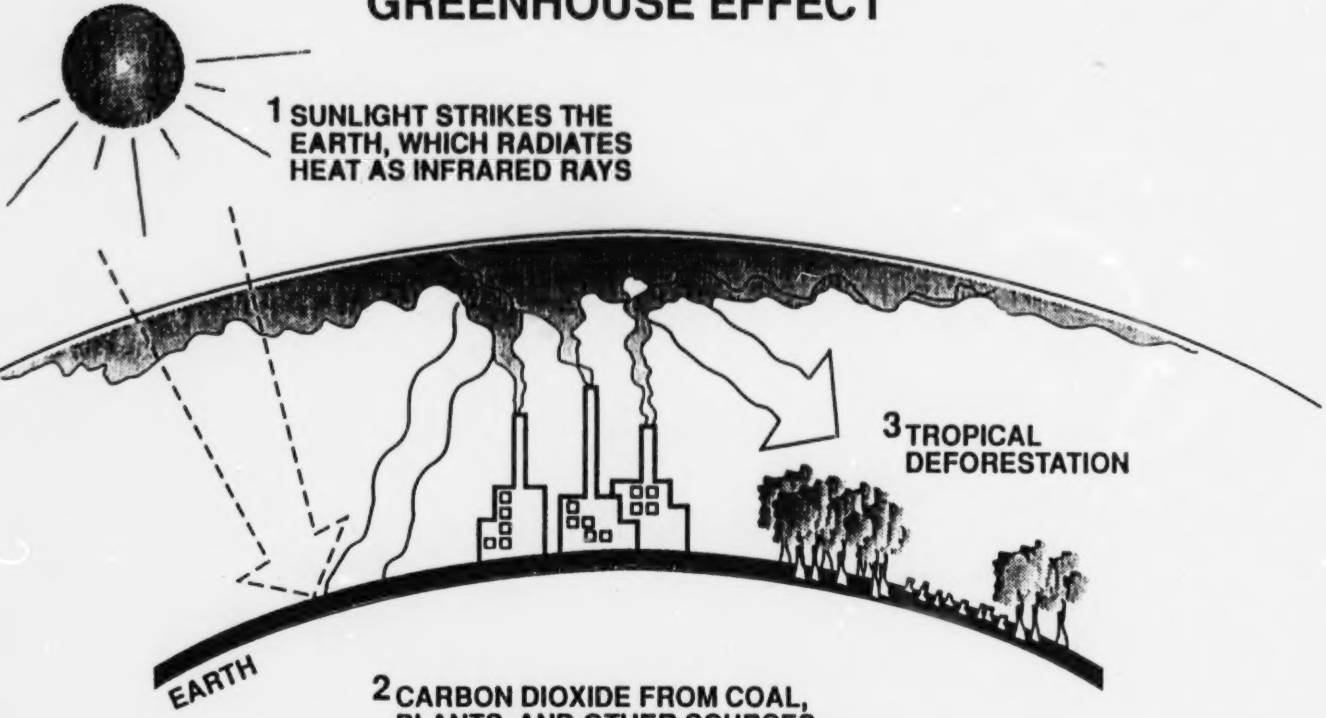
GREENHOUSE EFFECT



1 SUNLIGHT STRIKES THE EARTH, WHICH RADIATES HEAT AS INFRARED RAYS

2 CARBON DIOXIDE FROM COAL, PLANTS, AND OTHER SOURCES OF POLLUTION TRAPS SOME OF THE HEAT, WHICH RAISES THE TEMPERATURE

3 TROPICAL DEFORESTATION

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Earthworm Castles

Age: 5-15 years old

Goal: To help people observe and learn about one of nature's important recyclers — the earthworms.

Background:

Earthworms help make good soil. They dig tunnels that let in air and keep the soil loose. Earthworms are important recyclers because they eat bits of decayed plants and animals that are in the soil.

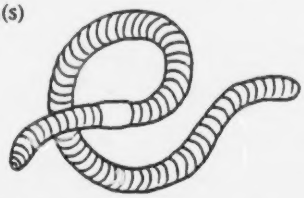
Earthworms' bodies are simple structures composed of two tubes, one within the other. The inner tube is the digestive system. The black color is the food in the digestive tract.

Earthworms belong to a group of animals having segmented bodies. Each segment is the same except for the head and the clitellum. The head, the end which moves forward, has a mouth, but no eyes. Worms do not need eyes underground. The clitellum is the swollen ring around the body. It contains many glands which secrete mucus to form the walls of a cocoon. The eggs in the cocoon are fertilized, and left to hatch in the soil. Earthworms are bisexual — each individual contains both male and female parts.

Earthworms do not have any legs. They move by extending their front half forward and anchoring it with hair like structures called setae. Then their back half is pulled forward. Earthworms dig their tunnels by eating soil in front of them. The soil is then excreted with mucus to form the burrow walls. Castings, which are excess excreted dirt clumps, may be found on the surface of the ground. They look like tiny bunches of grapes. Castings have a high lime content and help fertilize the ground.

Materials: (per castle)

magnifying glass
large jar (ex. = a used mayonnaise jar)
rocks
soil
peat moss
worm food (Grass cuttings, tiny table scraps, egg shells, coffee grounds, etc.)
black paper
shovel(s) or spoon(s)



Procedure:

1. Introduce a group of children to a live worm and have them watch it move. Using a magnifying glass, observe the setae. Locate the clitellum. Show them how to tell the front part from the rear. Put some "worm food" near the mouth and see if it will eat.
2. Lead the children on a worm dig. Talk about where worms live and how they help nature cycle its nutrients. Using the spoons or shovels, have the children hunt for worms to put in the castles they will build.
3. Create the castles. Place a few rocks in the bottom of each jar. Add a mixture of soil and peat moss to a depth of about 10 cm (4 inches). Invite the worms into their new homes by carefully placing them in the jars.
4. Place some worm food on top of the soil. Foods that work well are: apple and banana peels, cantaloupe, watermelon, celery, coffee grounds, eggshells, onion peels, pizza crusts and tea bags. (To avoid fruit flies, completely cover the food with a layer of dirt.)
5. Keep the castle moist, but not wet.
6. Cover the jar with black paper. Explain that worms are sensitive to light.
7. Let the group take the earthworm castle home with them. Have them observe the worm tunnels, the worm castings and the worm eating habits. Do the grass cuttings slowly disappear? Remind the class to keep the soil moist, to keep the jar covered with the dark paper when they aren't watching the worms, and to add new "worm food" every few days. Suggest that the kids bring in table scraps from home. This way some of nature's recyclers are helping recycle some of the childrens' waste. Insist that the worms are returned to their natural habitat after the children are done observing them.

Going Beyond:

- Make an "earthworm-track observation spot". Pour water over some soil outdoors to make it muddy. Come back the next day and look for worm tracks. Discuss that worms need air to breath. They come out of the ground so they do not drown.
- Have young children pretend to be worms. Encourage them to close their eyes and move on the ground like earthworms.
- Make worm pictures by having a muddy worm crawl across a white piece of paper.
- Make an Earthworm Castle to have on display to show those people/groups who are unable to make their own castles.
- To observe another recycler, do the Mushroom Hike in this book.

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Microbe Garden

Age: 8-17 years old

Goals: To show decomposers at work and to have people understand the role molds play in the decomposition process.

Background:

Microbes are plants and animals that help decompose materials. These molds, bacteria, yeasts, and protozoa are responsible for turning decomposing matter into nutrient pieces that are small enough for plants to absorb. Microbes are better at this task than earthworms because of the amount of materials they consume. Under favorable conditions, an earthworm eats its own weight in food daily. A microbe digests its weight in food in just a few seconds. And, gram for gram there are more microbes in a compost pile than earthworms. Not only are microbes responsible for more decomposition, but they can digest many things earthworms cannot, including dead earthworms.

While microbes are small, many can be observed without a microscope. The molds that develop in mold gardens may be any color, size, or shape. The colors of molds are usually due to spores. Like airborne seeds of higher plants, spores help to propagate their species by blowing to new locations.

Some common molds that grow on bread include:
  rhizopus stolonifer (shiny black bread mold)
  aspergillus niger (fuzzy, black bread mold)
  penicillium (fuzzy, blue-green mold).

Each mold is really a colony consisting of millions of cells of one particular species. Many different molds may grow at the same time, or there may be sequential changes when some molds replace others.

Your mold garden is a model for what microbes do in well-aerated compost piles. Nature's recyclers, including the microbes, digest and oxidize garbage. The end product is good rich humus that enhances the fertility of soils.

Materials:

metal can or plastic jar (6-8" wide and 3-4" deep)
soil from garden or near shrubs
water
mold food (kitchen refuse - nut shells, potato peels, banana skins, old cereal, stale bread, apple cores, etc.) (No protein materials - meat, cheese or gelatin)
rubber band
clear plastic (cellophane)

Procedure:

1. Firmly pack about 1" of soil in the can or jar. Soil should be moist, but not water-logged.
2. Prepare 5 pieces of mold food, approximately half inch square and 1/8 to 1/4" thick.
3. Place the pieces of food on the soil, not touching one another.
4. Let the garden stand in the open air for about 15 minutes to catch spores.
5. Cover the container with plastic to prevent the garden from drying out. Use a rubber band to hold it in place.
6. Either use this microbe garden as a display, or let members of the group take it with them to observe and nurture.
7. Remove plastic for a few minutes each day to give the molds a good supply of oxygen. Add water to the soil when it dries out.

Going Beyond:

- Explain that mushrooms are the fruiting bodies of some molds. Go on a Mushroom Adventure hike (found in this booklet).
- Suggest that the group build Earthworm Castles to watch how earthworms help decompose materials.
- Make a mold garden using man-made, less-degradable materials (cellophane, brown paper, rubber etc.). Compare the rates of decomposition between the two gardens. Record your observations.
- Explain the life cycle of a mold.

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Mini-Composts*

Age: 9-17 years old

Goal: To help people learn about recycling in nature by watching nature's process at work in a miniature compost pile.

Background:

When we mention "recycling," we often think of recycling glass bottles, aluminum cans and newspapers. But another 20% of the household garbage we throw out could also be recycled. Food scraps, leaves, grass clippings and other biodegradable organic wastes can be recycled by composting. Simply stated, composting creates optimal conditions for decomposition to occur. Decomposition is the biochemical process by which bacteria, fungi and other microscopic organisms break organic "wastes" into nutrients that can be used by plants and animals. Decomposition occurs in nature whenever a leaf falls to the ground or an animal dies. It is essential for the continuation of life on earth. In order for decomposition to occur in a compost pile, several components must be present: soil, organic wastes, nitrogen, worms, water, air, time, heat and mass. Decomposition does not occur very rapidly, (if at all) in a landfill because two necessary components, air and nature's recyclers, are not there. The result of decomposition in a compost pile is a nutrient-rich humus that is excellent for improving soil quality and plant growth.

Materials:

aquarium
organic wastes
soil (not potting soil)
thermometer
trowel or large spoon
1-2 dozen red earthworms

Procedure:

1. Introduce the ideas of decomposition and natural recycling. Ask the group what the verb to "compose" means. (To make. For example, musicians make songs by putting words together.) Explain that decompose means to take things apart. Decomposers help nature recycle by breaking materials down so they can be cycled over and over again. This process can be accelerated in a compost pile. Ask: What is composting? What are the necessary ingredients for a good compost pile? How is composting related to the concept of recycling? How can composting reduce waste?

2. Assemble a variety of organic wastes in the aquarium, including leaves, needles, grass clippings, sawdust, hair, kitchen scraps, etc. Avoid meat scraps, dairy products, fats and oils which inhibit decomposition, cause odors and can attract pests. Chop wastes into small pieces. Leave some large pieces of the same materials to compare rates of decomposition between large and small items. Why might there be a difference?

3. Alternate layers of the materials as follows (amounts are approximate): inch of soil, two inches of organic waste, a sprinkle of manure or green grass clippings and a sprinkle of water — repeat.

4. Cover with an inch of soil. Water the pile enough to make it moist but not soggy. It should feel like a damp sponge.

5. Add earthworms.

6. Allow a school group to take the mini-compost home with them, or use it as a display piece on site. Place the compost pile where it will be at room temperature (not in direct sun). Gently mix the compost once a week to aerate it. Use a thermometer to test the temperature of the pile. Graph the results.

7. Discuss: How composting reduces the amount of waste that is thrown out, what happens to organic wastes that end up in the landfill, whether or not the landfill is a gigantic natural compost pile, and the problems with placing large amounts of organic material in landfills.

Going Beyond:

- Suggest that everyone build a real compost pile, either as a group at school, or individually at home. For directions, write to: Education Programs, Bureau of Information and Education, Dept. of Natural Resources, P.O.Box 7921, Madison, WI 53707. Ask for the Home Composting brochure.
- Make a second compost pile with non-biodegradable materials in it. (pop can, glass bottle, comb, can opener etc.) Every week compare/contrast the rates of decay of the two boxes.
- Sanitary Landfill versus Open Dump. Half fill two clear containers with soil. Put examples of solid waste in each container. Leave the open dump uncovered and occasionally water it lightly. For the sanitary landfill, cover the waste with several inches of soil. Observe for six months. What differences are there? What types of solid waste rotted?
- Just before the ground freezes in the fall, bury identical materials outside and in containers inside. Keep the indoor container moist and warm. In the spring compare the materials. Is temperature an important factor in decomposition?
- Try building a Compost Column using "Bottle Biology" directions. See Resources.
- Go on a hike to observe nature decomposing.

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* Adapted with permission from: AVR Teacher's Resource Guide, Association of Vermont Recyclers, P.O.Box 1244, Montpelier, VT 05602

"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Log Tag*

Age: 5-10 years old

Goal: To give children the opportunity to use what they learned about nature's recyclers and decaying logs.

Background:

Fallen trees and rotting logs are suitable habitats for many organisms, both plants and animals. As the log or tree decomposes, it becomes a host to different plants and animals. Insects bore into a tree's protective bark, allowing air, moisture and spores of fungi to enter the tree. The fungi grow, consumming the tree's starches and dissolving the wood structure. The fruiting bodies of the fungi are food to many insect larvae, bacteria, slugs and snails.

Gradually the log is covered with mosses and grasses. Earthworms, microscopic organisms and fungi continue the decaying process underground. It takes an average of ten years for a dead tree to turn to soil. Weather, temperature and moisture as well as tree type all affect the rate of decomposition, and thus, the type of organism found. The following is a list of organisms which could be described, discussed, and used in the game: raccoon, squirrel, owl, ant, beetle, earthworm, salamander, spider, chipmunk, lichen, bacteria, mushroom, butterfly, insect larva, moss, termite, microbes, millipede, centipede, etc.

Materials:

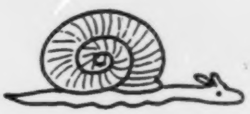
a group of people
a large open space such as a field or large campsite.

Procedure:

1. Gather a group of children and go to an open space.
2. Explain the rules to the children and choose one person to be "it". That person tries to tag other players. Other players can save themselves by crouching down before being tagged and naming a plant or animal that lives on, or in a rotting log. As long as the same person is it, there can be no repeating of plant or animal names.
3. If a player is tagged before he/she can think of an animal or plant name, than that player becomes "it".
4. Whenever a new player becomes "it," all plant and animal names can be used again.

Going Beyond:

- The Mushroom Hike or Observe a Log activities are good backgrounds for this game.
- Discuss which animal and plant names the children used. Did they forget any? Which ones?



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Mushroom Adventure

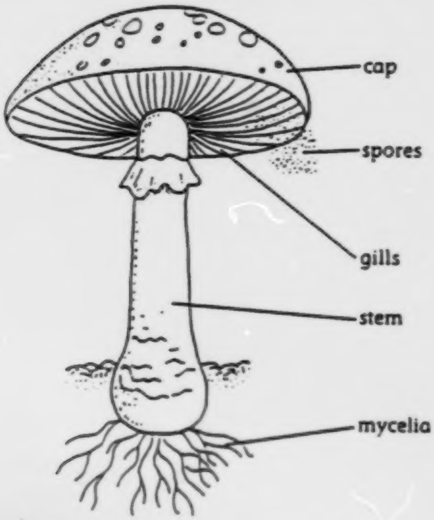
Age: 10 - adult

Goals: To teach people about mushrooms and their important role in nature's recycling system.

Background:

Mushrooms are an important part of nature's recycling team. Some mushrooms are parasites on living trees, but most mushrooms are saprophytic, using only dead materials for food. They cause decay of dead leaves, animals, and wood in the forests. Where forest soils are too acidic for bacteria to grow well, mushrooms are the main decay producers.

Mushrooms have an interesting life cycle. Tiny seed-like spores are released into the air from the fruiting body of mushrooms. When a spore lands in a fertile location, it sends out many root-like threads called hyphae. These tiny threads grow into a tangled mass called a mycelium. The mycelium is the underground part of the mushroom that chemically breaks down the material on which it eats and grows. When the mycelia are strong, and conditions are good, small mushroom "buttons" begin to form beneath the soil. The buttons take in water, swell and push up out of the soil. Gradually the mushroom's stem emerges and the cap opens like an umbrella. The cap is lined with gills that hang next to each other. Each gill contains many cells that make spores. After spores are mature, they can be dispersed by wind, water, animals and insects.



Not all mushrooms are umbrella shaped. Some grow on the side of trees like shelves. Others are globe-shaped and are called puff balls.

Prior to the hike it may be beneficial to learn the specifics about species which grow in your area. It will also help to have a mushroom identification book along on the adventure. The hike is most successful from July to September when the greatest number of species and the heaviest densities of mushrooms may be found after drenching rains.

Procedure:

1. Assemble the group. Depending on the group size, your facility, and visual aides, you may want to teach several points before going out in the field.

- Stress the importance of a detailed study of mushrooms before anyone attempts to gather them for food. Advise people to look at them, photograph them, and to enjoy their many colors and pleasing forms, and forget about eating them. Many people die each year because of mistakes in mushroom identification.
- Emphasize the lack of chlorophyll in mushrooms and the habitats of various mushrooms. Explain their extensive "root" systems, tremendous spore production and rapid growth rates under favorable conditions.
- Discuss the specific habitat requirements of mushrooms you may see on the hike.
- Stress that mushrooms are the fruiting bodies of their extensive, hidden "root" systems (mycelia) and that most mushrooms grow, ripen, disperse spores and die in just a few days. Their important roles in the nutrient cycle should also be brought out during the hike.

2. Go on the Mushroom Adventure. Look for mushrooms. Practice identifying them. Note key characteristics such as stem length and width, color, habitat, texture, spore color and gill pattern.

Going Beyond:

- Do the Spore Print activity from this booklet.
- Further study spores and molds. The spores that create mushrooms are similar to those that create molds. To see how airborne spores grow hyphae and fruiting bodies, do the following:

Place a slice of damp bread in a glass dish. Leave it uncovered for several minutes. Then cover the dish with a glass plate. Set the dish aside for several days in a warm, dark place and see if any mold grows on the food. Observe the molds with a magnifying glass. Can you see the center point from which the hyphae grow? How did the molds start at these points? The air we breath is filled with spores that produce molds and mushrooms. Like mushroom spores, mold spores can only grow when they land in favorable conditions such as the damp bread.

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Spore Prints

Age: 6-adult

Goal: To introduce people to one of nature's recyclers — the mushroom.

Background:

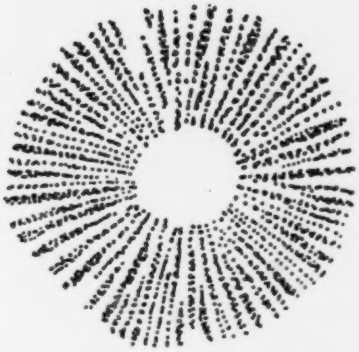
Mushrooms belong to a group of living things called fungi. A fungus is a plant that does not contain chlorophyll. It isn't green. It can't make its own food through photosynthesis. It must gather its food from decaying and living matter. Mushrooms are important members of nature's recycling team. These decomposers chemically break down dead vegetation, animal bodies, and manure into usable nutrients.

The part of the mushroom that people see, the fruiting body, is only part of the whole plant. The rest is hidden in the substrate. Mushrooms grow from spores which are tiny seed-like structures. A little thread, called a hypha, grows from each spore. The hyphae grow and become entangled with one another, forming masses of hyphae called mycelia. As the mycelia grow, chemicals are released which dissolve the object leaving food for them to eat.

When the conditions are right, small mushroom "buttons" begin to form beneath the soil. The buttons take in water, swell, and push up out of the ground. Gradually the stem grows, the cap opens, and flattens. The mushroom ripens and disperses its own spores — thus starting the cycle over again.

Use mushrooms from the grocery store rather than from your property because natural supplies could be permanently depleted. This provides a nice opportunity for people to learn by example that nature can be observed without being ruined.

In this activity you will see ripened spores. The unique gill pattern of spores results from the spores falling from the gill surface where they are formed.



Materials:

1 mushroom with gills, per person
1 piece of black paper per person
1 piece of white paper per person
1 bowl per person
Knife

Procedure:

1. Explain the life cycle of mushrooms to the group.
2. Distribute store-bought mushrooms and paper. Some spores are dark, and others are light. Unless the leader predetermines the color of spores, (light spores/dark paper, dark spores/light paper), people should be given one black and one white piece of paper so that the spores will show up on one of the pieces.
3. Cut off the stem close to the cap. Place the cap, gill-side down, on a sheet of paper. If the spore color has not been predetermined, place the cap half on a white sheet and half on a black sheet.
4. Cover the mushroom cap with an inverted dish or bowl. This prevents air currents from dispersing the spores. Leave it undisturbed for several hours — overnight if possible. When the cap is lifted there will be a unique spore print. Encourage people to take the spore print home and frame it.

Going Beyond:

- Take the group on the Mushroom Adventure found in this booklet. This hike will help the group observe mushrooms outdoors in their natural setting.
- Explain that spore prints are important traits when identifying mushrooms. Distribute mushroom guides to see if the mushrooms are identifiable by their spore prints.
- To observe another one of nature's recyclers — build an Earthworm Castle.

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Dead Tree and Rotting Log Study

Age: 8-adult

Goals: To help people develop an understanding of the decomposition process and the role nature's recyclers play in recycling nutrients.

Materials:

magnifying glasses or hand lenses
clear plastic
dark plastic or heavy fabric
saw
hammer and chisel
staple gun and staples

Background:

The death and decay of a tree is a very dynamic process that provides us with one of the best teaching examples of recycling in nature. Standing dead trees and downed, rotting logs can be found in most forest communities in various stages of decomposition. They serve as excellent habitats for a variety of organisms known as decomposers or nature's recyclers. By observing and comparing these various stages of decay, you can virtually watch a tree return to the soil.

Procedure:

1. Early in the season, locate the following in close proximity to each other: small live tree, large live tree, standing dead tree, freshly fallen tree, log in initial stages of decay, log well along in decay, and punky remains of a log.

2. If possible, make a "window" in the standing dead tree by cutting out a 10 inch square section of bark at a good viewing height. Cut "windows" into the rotting logs by making two cross cuts approximately 10 inches apart and one inch deep in each log. Chisel out the section between the cuts to a depth of one half to one inch. Staple a thin sheet of clear plastic over each window, leaving a gap underneath. Punch a few air holes in the plastic. Finally, cover each window with a "shutter" made from a piece of dark plastic or heavy fabric. Staple just the top edge of the material and weight the bottom so that it will not blow around. These "windows" will enable you and your class to view nature's recyclers without continually disturbing them and destroying their homes. The "shutter" keeps the space underneath dark and more inviting to nature's recyclers.

3. Take your class on a discovery hike in search of nature's recyclers. You may want to develop a worksheet for older students to record their observations, or just arm them with magnifying glasses and guide them through the discovery process. If possible, let your students work in small groups of three to five.

4. Start with the two live trees and ask: What makes them grow? Where do they get their nutrients from? Will they live forever?

5. Next go to the standing dead tree and ask: What happened to the tree? What caused it to die? What will happen to it now? Direct your students to look for evidence of nature's recyclers at the tree. Open the "window", examine crevices (cautiously), and search the ground around the tree. Look for plants (mushrooms and lichens), birds (woodpeckers and sapsuckers), mammals (squirrels and chipmunks), amphibians (salamanders), insects (ants and termites), and other members of nature's recycling crew (millipedes, sow bugs, mites, earthworms, etc.). Ask your students what role each recycler plays in the decomposition process. Have your students close their eyes and feel the texture of the tree. Ask them for descriptive words (adjectives) about what the feel. Have them smell the tree and describe its odor.

6. Visit the freshly fallen tree and the rest of the logs in decreasing stages of decay. Ask similar questions and have your students make the same observations as they did for the standing dead tree.

7. After your students study the punky remains of a log ask: What is left from the tree/log? (minerals and some organic matter) Where did the rest of the tree go? (some back into the air and water, some into nature's recyclers). Dig up some soil nearby (first horizon) and compare the way it looks, feels and smells with the log remains. Are they similar? Review what you have found and learned.

8. Finally, go back to the small live tree and ask your students where it gets its minerals to grow. Talk about completing the cycle and how the same resources have been used over and over again.

Going Beyond:

- Discuss what happens to organic materials that we landfill. Why don't they get recycled? (no air, no sun light, limited moisture)
- Discuss what we can do to be more like nature's recyclers.
- Study nature's recyclers in the wintertime by collecting some forest floor litter and warming it with a lamp. Dormant "recyclers" will come to life under the heat from the lamp.
- Collect sow bugs, several fallen leaves and other decaying plant material. Place them in a closed container with a few drops of water. Remember to punch a few air holes in the lid. Observe the sow bugs for a few days, and then let them go.

TREE
AMIGOS

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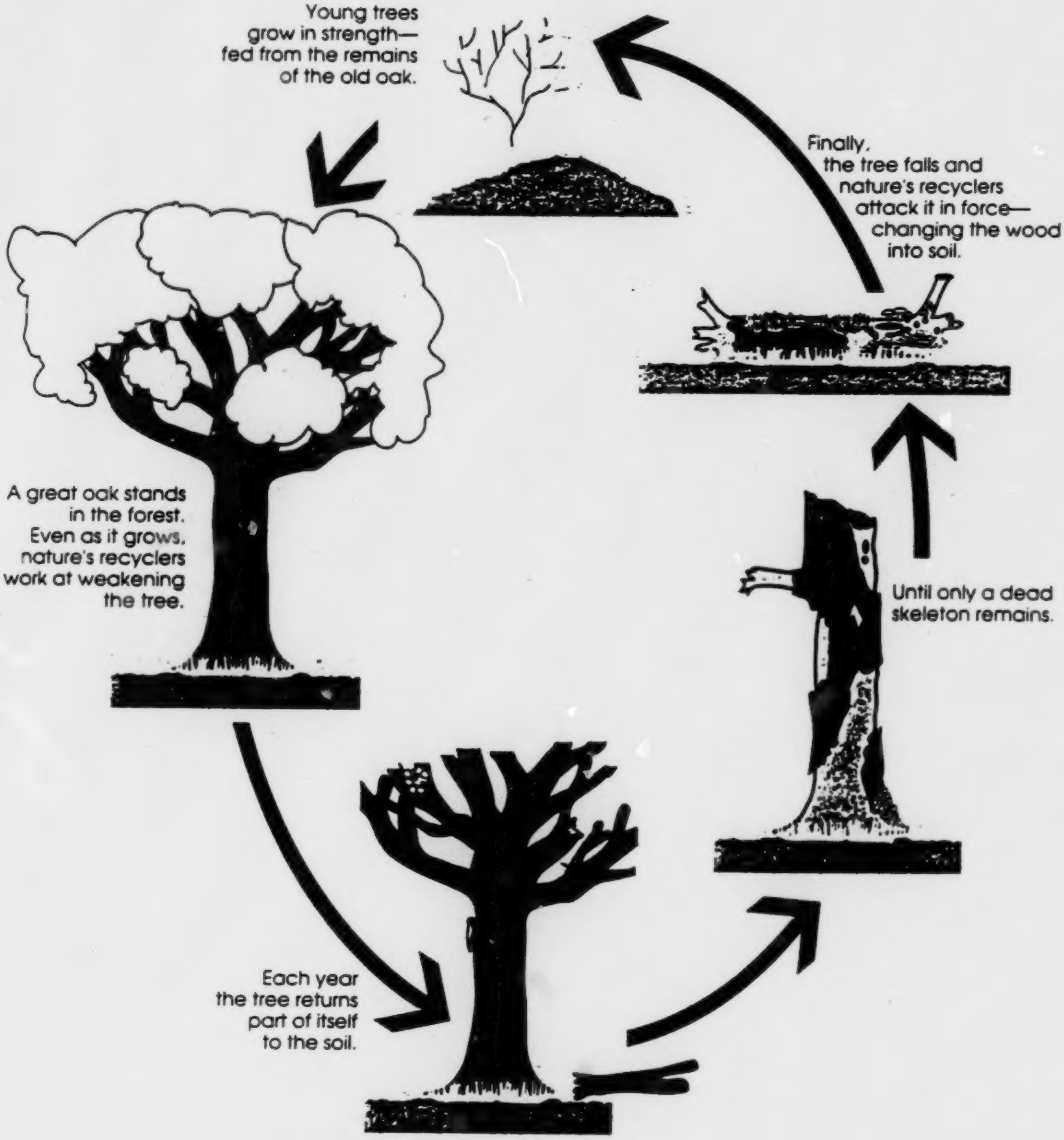
Nutrient Recycling in Trees


Young trees
grow in strength—
fed from the remains
of the old oak.
Finally,
the tree falls and
nature's recyclers
attack it in force—
changing the wood
into soil.
A great oak stands
in the forest.
Even as it grows,
nature's recyclers
work at weakening
the tree.
Until only a dead
skeleton remains.
Each year
the tree returns
part of itself
to the soil.

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Rotting Logs Puppet Show

Age: 5-14 years old

Goal: To show children that many of nature's recyclers utilize dead, decaying logs.

Background:

Rotting logs are homes for many animals. As logs rot, different animals inhabit each stage of decay. Raccoons, squirrels, owls and woodpeckers like trees that are in the beginning stages of decomposition. They use the big holes as homes. Spiders like decomposing logs during the intermediate stages of decomposition because many other bugs are there to capture and eat. Earthworms, slugs, and snails like trees in the final stages of decay when the trees are changing to soil. The new forming ground is moist, loose and rich in nutrients.

The following puppet show/play can either be done with puppets, or with actors. The actors/puppeteers can either be park staff/volunteers, or children. Created puppets with paper lunch bags and construction paper or old socks and yarn scraps. Because of the reading involved, it is recommended that older children play the parts.

Materials:

a real or constructed rotting log
3 pieces of paper with "Directions", taped to a stick
4 costumes or 4 puppets (bear, spider, raccoon and a worm)

Procedure:

1. Either choose 4 children to be actors/puppeteers or have staff people participate. Encourage the actors to really act out the role of their animals. For example, the worm should wiggle on the ground, and the spider should walk daintily. Tell everyone else it is their job to be a good audience.
2. Perform the Rotting Logs Show.

Rotting Logs Show*

Characters: Rocky Raccoon
Benji Bear
Charlotte Spider
Wendy Worm

Rocky: Benji Bear, I've been looking for you. As king of the forest you must have a list of all the individual homes around here.

Benji: I sure do. Are you in need of a home, Rocky Raccoon?

Rocky: Yes I am. Nothing too fancy, no moss to moss carpeting or anything, just a fairly dry place with a roomy hole for me to stay in.

Benji: I know just the home for you Rocky. It has a soft, comfortable floor and thick, well-insulated walls. I'm sure you'll find it a perfect, snug home for the winter. Just follow these simple directions and you'll have no trouble finding it.

(Hands him a piece of paper)

Rocky: Thanks a lot, Benji.

(Walks off: Charlotte Spider appears)

Charlotte: Hey Benji, I'm in need of a home too. Do you have anything for me?

Benji: What kind of place are you looking for Charlotte Spider?

Charlotte: The older the better, with a lot of little cracks and crevices for me to crawl under and through. I need a safe place for my sac of eggs and a spot where I will be protected and warm enough to spend the winter.

*"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
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P.O. Box 7921
Madison, WI 53707

Benji: I've got the perfect place for you, Charlotte. This home will help protect you from predators and will be a great place for you to find food. These directions will show you how to get there.

(hands her same paper and Charlotte walks off; Wendy Worm appears)

Wendy: Oh Benji, can you help me? I'm having a terrible time finding a home.

Benji: Sure, Wendy Worm. What kind of home do you want?

Wendy: Us worms go for damp soil. It offers all the comforts and conveniences of ground life. I'd like a soft place with lots of rotting things so I can find good food.

Benji: Well, it just so happens I know of a place with nice, rich, damp soil. Here are the direction to get there.

(hands her same paper)

Wendy: Thank you Benji. I knew I could count on you.

(log comes up: Rocky and Wendy each approach it from opposite sides)

Rocky: This rotting log over here must be my new home.

Wendy: Your home! Benji Bear told me it would be my new home.

Charlotte: *(creeping up over the log)* Hey you guys, quit the joking. This is my new home.

Rocky and Wendy: Your Home!

Rocky: We can't all live in the same place. I'm a raccoon and I need solid walls and nice dry leaves.

Charlotte: I'm a spider, and I like small spaces to hide in and places to catch my food.

Wendy: And I'm a worm. I'm a prisoner inside solid walls, and dry leaves are rough on my skin. I like dirt, myself, where I can move around easily.

Charlotte: I don't know. What do you think, audience? Could we all use the same rotting log for our homes?

(wait for answer)

Rocky: There's a nice big hollow space at this end for me.

Charlotte: The middle of the log has great places for me to crawl around in and plenty of juicy insects to eat.

Wendy: Well, I can live over at this end where the rotting wood has almost turned to soil.

Rocky: So, I guess we all can live together. *(yawns)* I better go test my new bed. *(leaves)*

Charlotte: This rotting log provides a nice home for each of us. I think I'll hide behind here and wait for dinner. *(leaves)*

Wendy: So it doesn't matter that I'm a worm, and he's a raccoon and she's a spider. Life in this log is good for all of us. I better go burrow in that damp soil; this dry air is too much for me. Bye, bye everyone. *(leaves)*

Going Beyond:

- Play Log Tag, go on a Mushroom Adventure, build an Earthworm Castle, or study a Dead and Rotting Log. (All activities found in this book.)

THE EARTHWORM DOES THE WORK

Science Activity

Students will understand the functions of the earthworm and its relation to the soil. and recognize that animal recycling of organic wastes improves soil structure.

MATERIALS NEEDED

2 terrariums or glass containers, earthworms, soil, leaves

BACKGROUND

The earthworm consumes its own weight in leaves and grass every 24 hours. It returns nutrients to the soil. Worm castings contain minerals. Worm tunnels open spaces for roots and water. Worms cannot hear or see, but they are sensitive to light and vibrations. They will eat dead leaves, twigs and insects and, in turn, are eaten by some birds and burrowing animals.

IMPLEMENTATION

Share background information on worms with students prior to setting up two containers with leaves, soil, sand, and clay. Terrariums or large glass jars are excellent containers as they allow students to easily observe what is occurring.

Ask students to collect worms outside or bring them from home. Place the worms in only one of the containers. Keep the soil of this container slightly moist.

Describe and draw pictures of the soils of both containers. Ask the students to predict what will happen to the soils.

Cover the worm container with black cloth or paper. Allow air holes for breathing.

After three to four days, remove the paper and observe the worms and soil layers. Compare the soil in the two containers.

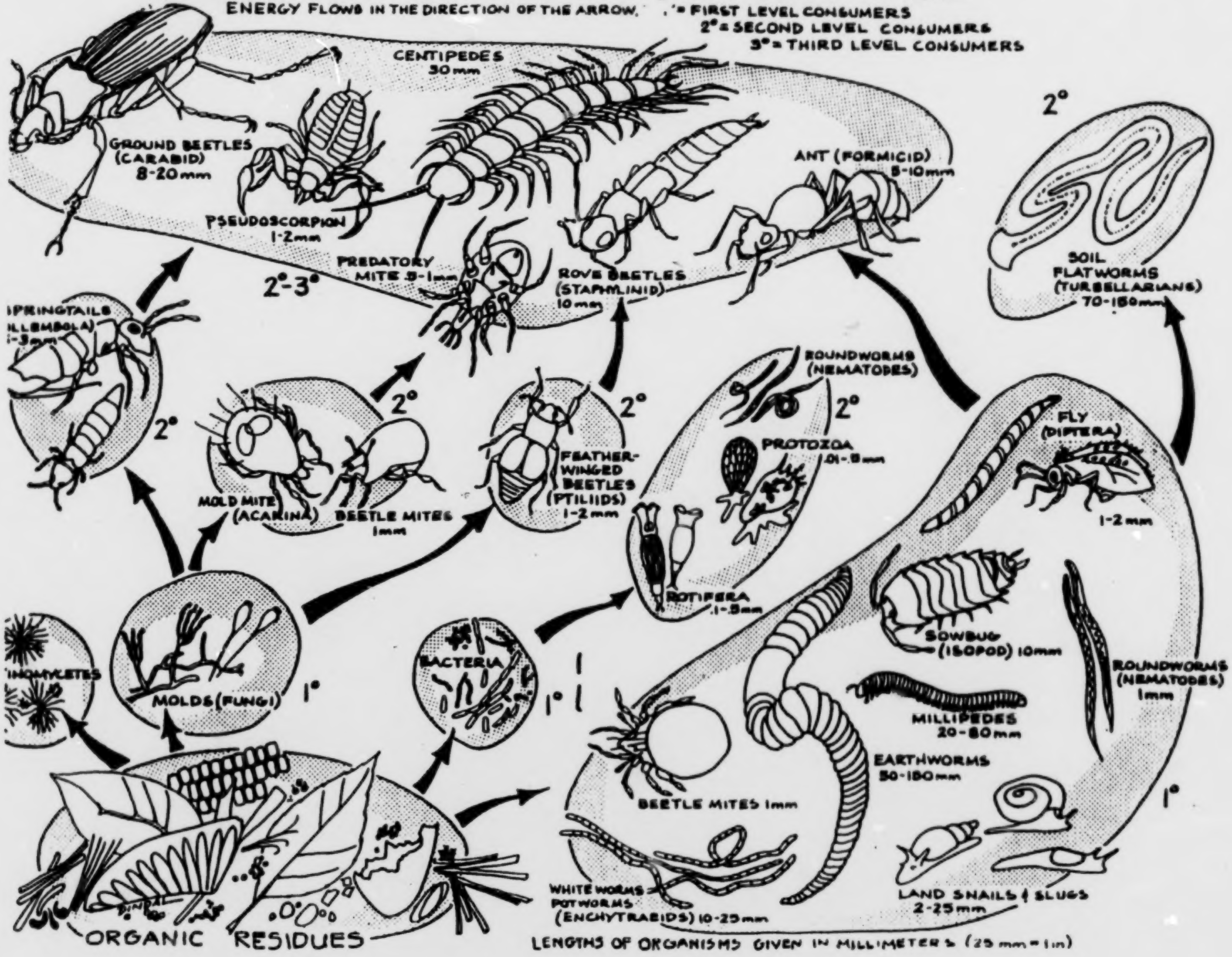
Continue to observe the activities of the worms. Notice the differences between the contents of the two containers. While the leaves in the "wormless" container will begin to break down, they will decompose more slowly. Discuss how the worm is able to recycle materials by digesting dead material and returning it to the soil. When finished, return worms to soil in an outside garden.

SOURCE

Project Learning Tree

"Oscar's Options"
83 Park St
Providence, RI 02903

FOOD WEB OF THE COMPOST PILE



ENERGY FLOWS IN THE DIRECTION OF THE ARROW.
1° = FIRST LEVEL CONSUMERS
2° = SECOND LEVEL CONSUMERS
3° = THIRD LEVEL CONSUMERS
GROUND BEETLES (CARABID) 8-20 mm
PSEUDOSCORPION 1-2 mm
CENTIPEDES 30 mm
PREDATORY MITE .5-1 mm
ROVE BEETLES (STAPHYLINID) 10 mm
ANT (FORMICID) 5-10 mm
2°-3°
2°
SOIL FLATWORMS (TURBELLARIANS) 70-150 mm
SPRINGTAILS (COLLEMBOLA) 1-3 mm
2°
MOLD MITE (ACARINA)
BEETLE MITES 1mm
2°
FEATHER-WINGED BEETLES (PTILIIDS) 1-2 mm
2°
ROUNDWORMS (NEMATODES)
2°
PROTOZOA .01-.5 mm
ROTIFERA .1-.5 mm
FLY (DIPTERA) 1-2 mm
ACTINOMYCETES
MOLDS (FUNGI)
1°
BACTERIA
1°
SOWBUG (ISOPOD) 10 mm
ROUNDWORMS (NEMATODES) 1 mm
MILLIPEDES 20-80 mm
EARTHWORMS 30-150 mm
BEETLE MITES 1mm
1°
WHITE WORMS POTWORMS (ENCHYTRAEIDS) 10-25 mm
LAND SNAILS & SLUGS 2-25 mm
ORGANIC RESIDUES
LENGTHS OF ORGANISMS GIVEN IN MILLIMETERS (25 mm = 1 in)

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Providence, RI 02903

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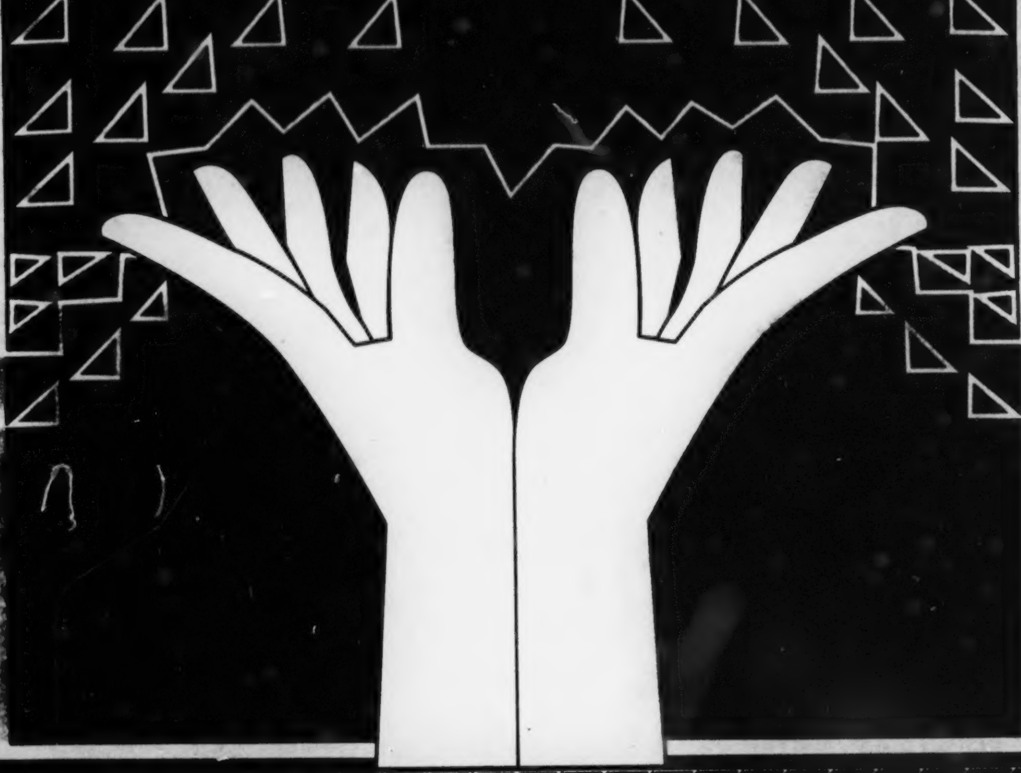
LEARNING ACTIVITIES

LAND USE



LAND USE CONCEPTS

HABITAT

VEGETATION AND SOIL TYPES

URBAN AND RURAL

HUMAN IMPACT

POLLUTION

HUMAN LAND USE PATTERNS

PRESERVATION, PROTECTION AND RESTORATION

LEARNING ACTIVITY: Half-Acre Study

OBJECTIVES: Develops scientific observation and classification skills; improves mapping skills; improves understanding of ecological relationships.

AGES: Junior and Senior High School

MATERIALS:

- *Paper*
- *Pencil*
- *Access to Camera*
- *Photographic Film*
- *Ruler*

DESCRIPTION: This field ecology project, designed by Dr. Kay T. Dodge, will help your students develop their scientific investigation skills as they get in touch with their sense of wonder. This activity can also be done by student teams.

See Student Directions and mapping samples (ready for copying) which follow.

HALF-ACRE STUDY (STUDENT DIRECTIONS):

I. **SELECTION**: Select an area for your observation which has little or no direct influence from man. Your area should be a half acre (200'x200') or more. You should make at least three or four visits to your area during your study, so make it accessible to you. Try and make your visits at different times during the day and/or night, so that you can observe the maximum amount of wildlife. Careful and sensitive observations will be necessary, so plan on spending some time in your area, getting to know it and observing it ecologically. Remember to keep our precious sense of wonder. Sit, listen, probe, observe, and record all the visual and sensory stimuli you receive. Looking and really seeing are two very different things.

II. **REPORT OUTLINE**: Your report should be turned in in a folder in the following order. It should be neat and well-organized (typed if possible).

A. **TITLE PAGE**: Name of your area, location and your name

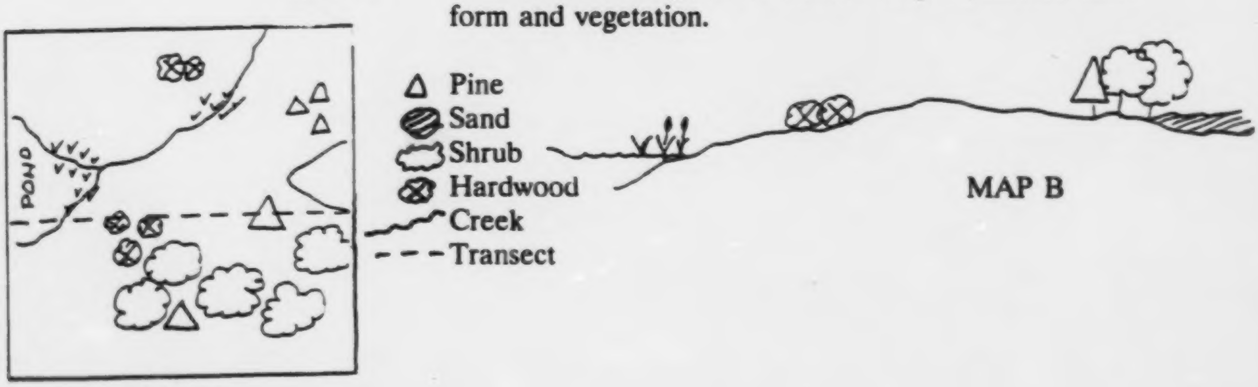
B. **TABLE OF CONTENTS**: In order, listed as follows:

C. **ECOLOGICAL DESCRIPTION**: This is the body of your report, describe ecologically the interrelationships you observe in your area. Your description should be about three pages in length, including; terrain, vegetation, stage of succession, physical factors, etc.

D. **MAPS OF YOUR AREA**: Stake out your area or section it off for mapping.

MAP A: Overhead view: Make a complete map using symbols for major vegetation areas, land forms, and other areas of interest. Include a key for your map and indicate the size of your site.

MAP B: Do a transect map, show line on map A, include land form and vegetation.



MAP A.

MAP B

E. **PHOTO STUDY**: Make a photo study of your area. This should include at least six photos showing the total area and other more detailed aspects of your area. Mount the pictures on several pages and write a complete ecological description of what should be seen in the picture. Put along side picture.

TAKE YOUR PICTURES EARLY ENOUGH, you must have pictures with your project.

F. **CLASSIFICATION OF ORGANISMS**: Make a list of all the plants and animals you observe on your visits, also indicate those you know are there from other signs. Take time to look and really see...dig, poke, pick up logs, look under rocks and leaf litter. Classify the animals and plants under the following categories: Mammals, Birds, Reptiles, Amphibians, Fishes, Invertebrates(insects, mollusks, annelids, etc.) Woody Plants, Herbaceous Plants, and Non-green Plants. Identify to genus-species where possible (see tree keys). You may preserve several specimens of major vegetation types between sheets of clear contact paper and label, although this is optional.

G. **SOIL SAMPLE AND PROFILE**: Observe a soil sample for your area, make a cross-section diagram showing the size of the layers. Include: litter, top soil and sub-soil layers.

H. **REFERENCES**: Make a complete bibliography of all materials used in identification and reference.

TREE AMIGOS ACTIVITY

LEARNING ACTIVITY: Exploring a Watershed

OBJECTIVE: To develop an understanding of the geological, ecological and cultural nature of a watershed using a state highway map.

MATERIALS: Michigan State Map (Highway maps available free from State Offices or Officials)
Two colored markers

AGE: 4th Grade to adult

DESCRIPTION: This activity uses a highway map to identify the boundaries of a watershed as well as population centers and political divisions. Participants will draw conclusions related to land use, possible sources and fates of pollutants, and solutions to existing problems. Designed by Kay T. Dodge, Ph.D.

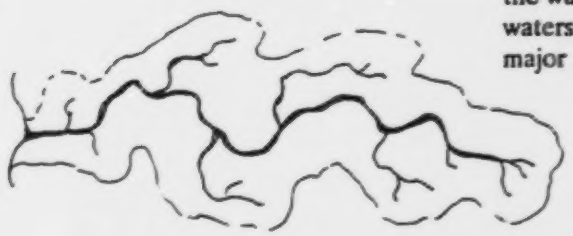
DIRECTIONS: This activity is suited for teams of two. The facilitator can read the directions step by step giving time for each procedure or give the instructions to the groups to do independently.

1. Locate the Grand River on the Michigan State Map (or a large river system in your state).

2. Locate the mouth of the river, then follow it back to its source (using a colored marker). Identify the mouth and source areas.

3. Make a list of all the rivers and major creeks that flow into the Grand River. Mark these rivers the marker.

4. After marking the rivers and streams back to their source, use a different color to enclose the watershed. The line will fall between Grand River watershed streams and those flowing into another major river system.



5. List the counties which are found in the watershed.

6. List the cities and towns in the watershed.

7. Describe the watershed (land form, development, land use patterns).

8. List possible pollution sources and discuss their impact and how they might be controlled.

9. A group listing and discussion should follow.

SHRINKING HABITAT

Objectives Students will be able to: 1) describe some effects of human development of land areas on plants and animals previously living in the area; 2) evaluate the importance of suitable habitat for wildlife; and 3) recognize that loss of habitat is generally considered to be the most critical problem facing wildlife today.

Method Students simulate a process of land development in a physically-involving activity.

Age: Grades 4-7
Subjects: Social Studies, Science
Skills: application, comparing similarities and differences, description, discussion, evaluation, generalization, kinesthetic concept development, observation, synthesis
Duration: one 45-minute period or longer
Group Size: minimum of six students, with one developer, one carnivore, three herbivores, and one tree
Setting: indoors or outdoors, large area with room for people and props
Conceptual Framework Reference: I.A., I.B., I.C., I.C.1., I.C.2., I.C.3., I.C.4. I.D., II.B.2., III.C.1., III.D.2., III.D.3., III.D.4., IV.C., IV.C.1., IV.C.2., IV.C.3., IV.E.10., V.A., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.B.1., VI.B.2., VI.B.3., VI.B.4., VI.B.5., VI.C., VI.C.2., VI.C.12. VI.C.16., VI.D., VI.D.1., VII.A., VII.A.1., VII.A.2., VII.A.3., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7.
Key Vocabulary: habitat, food chain, development, herbivores, carnivores, vegetation, consequences

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Background

All around us, and all over the planet, wildlife habitat is being lost. Whenever an area of land is paved for a shopping center, divided and excavated for homes for people, and sometimes when it is plowed to grow a crop—small animals lose their homes, and frequently their sources of food and water. As these small animals disappear, so too do the larger animals that previously depended upon the smaller animals in the food chain as a source of food. Animals that cannot tolerate human intervention may also disappear without any direct relationship to the food chain. (For example, see "Too Close For Comfort.")

Students can observe this phenomenon near their homes and schools, or at least in their region. This process is happening in large ecosystems and small, all over the earth.

For example, many wetlands on the planet have been filled in and drained to make land for farming and homes. When they are filled in, many kinds of water birds, reptiles, amphibians, crustaceans, and other life forms—including a wide variety of vegetation—are lost. Sometimes the animal forms can move on; most often they cannot.

Some of the tropical forests of the planet have become extremely vulnerable in recent years. Scientists estimate that huge numbers of plant and animal forms exist in these forests that have not even been identified as yet. They are tremendously important sources of the earth's biological diversity. In fact, some scientists warn that as these genetic pools are reduced, the flexibility and thus capacity to survive of the remaining plants and animals on earth will ultimately be reduced.

The major purpose of this activity is for students to simulate some of the potential impacts of land development on wildlife and its habitat, to recognize that this process is one that is taking place in areas all over the planet, and to understand that loss of habitat is generally considered to be the most critical problem facing wildlife today.

Materials

green and blue construction paper; classroom desks, tables or chairs; five or six large bedsheets or blankets for a student group of about 25

Procedure

1. Review with the students the elements necessary for a habitat (food, water, shelter, and space arranged suitably for the particular animal). (See Components of Habitat in the "Cross References.") After some discussion to make sure that the elements of habitat are clearly in mind, tell the students that in this activity they will be simulating wildlife in its habitat.

2. Divide the students into four groups: **herbivores**, **carnivores**, **vegetation** (trees, shrubs, grasses, etc.), and people who will be **land developers**. If the students are not familiar with the terms "herbivore" and "carnivore," provide them with working definitions of those terms (herbivore—a plant-eating animal; carnivore—a meat-eating animal; and although not needed for this activity, omnivore—an animal that eats both plants and animals). Plan for three times as many herbivores as carnivores with a small number of developers in proportion to the other two groups. The numbers (amount) of vegetation may vary. For example, two developers, three carnivores, nine herbivores, and six trees or bushes (vegetation).

3. Establish a large area—either in the classroom, with tables, chairs, and desks moved to the sides of the room, or outside—that can be used to simulate the wildlife habitat area before development. The "land developers" are to stay on the sidelines at this time, simply observing the undeveloped land and its wildlife inhabitants—or meeting on their own, nearby, to make plans for development. In fact, they can make their entrance rather suddenly once the wildlife habitat has been established—simulating the arrival of heavy construction equipment.

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4. Provide each "herbivore" with:

- two desks or chairs to use as "shelter" (or string or hula hoops);
- three pieces of green construction paper to represent food;
- one piece of blue construction paper to represent water; and
- some of the vegetation portrayed by students.

Provide each "carnivore" with:

- one desk or chair to use as a "lair" (or string or hula hoop);
- space equivalent to that used by three herbivores;
- three herbivores as a potential food source;
- one piece of blue construction paper to represent water; and
- some of the vegetation portrayed by students.

5. Ask the "herbivores" to arrange the food, water, and shelter—including the students who are "vegetation"—in a space to represent their habitat. Once the herbivores have arranged their habitat, ask the "carnivores" to move into the area to establish their lairs and water sources, keeping an eye on the herbivores as possible food sources. For added interest, suggest that the students identify what particular kind of animal they are, and role-play its characteristics. (This phase takes about ten minutes, with the developers planning while the herbivores and carnivores arrange their habitat.)

6. Once all the animals are established in their habitats, it is time for the developers to enter the picture. These developers have been given the opportunity to create a housing and shopping area. (They may use three to seven minutes to construct their development, explaining their actions as they take them.) They are restricted in how much space they can use. They may use the space equivalent to that used by three herbivores. The developers may use the sheets and blankets to build their development. They may remove trees, represented by students (without physically hurting the students), shelter, (represented by desks), food and water.

7. Once they have constructed their development, engage all of the students in a discussion of what happened. What action took place? With what consequences? Would or did any animals die? From what causes? Could the developers have done anything differently to change the consequences? Could they have developed several scattered small areas instead of one large area, or vice versa, with what effects? Would it have reduced negative consequences for wildlife if they put the development in a different area of the habitat? Rather than negative consequences, were there positive consequences? If so, what were they? How were they achieved? Ask the students to consider and discuss what seemed realistic about the activity, and what did not. For example, sometimes development can take place that enhances the area for some kinds of wildlife. Often, however, it will not be the same kinds of wildlife that were in the area before development. Planners and developers can sometimes add to the vegetation in an area, creating additional shelter and food for some kinds of wildlife, and make water sources available under some conditions, if there is insufficient water in the area.

8. Ask the students to summarize some of the possible impacts on wildlife from human activities like development of land areas. Are there places in your community where wildlife habitat has been lost by human development? Are there places where wildlife habitat has been enhanced by human activity? What choices, if any, are there to development of previously undeveloped areas? What trade-offs are involved; for example, in developing vacant areas within communities rather than undeveloped areas outside of communities? If development does take place, what kinds of actions can people take to minimize the negative consequences for wildlife, vegetation, and other elements of the environment? What about possible economic costs? Social costs? Ecological costs? Aesthetic costs? etc. Discuss loss of habitat as something that is affecting wildlife all over the planet. Ask the students to summarize the importance of suitable habitat for wildlife. Discuss the students' concerns and recommendations.

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Extensions

1. Conduct this activity twice, with the students trading roles the second time. When the former wildlife become land developers, they could see if they could produce a development plan that could benefit the area for people and wildlife in some ways. The activity can also be conducted to show differences between developing the entire area—with likely loss of all wildlife in the area—to developing only part of the area, with some wildlife likely to survive.
2. Ask students to complete the following sentence, and discuss their response: "If I were going to build a house for my family in a previously undeveloped area, I would . . ."

Evaluation

Name and describe three animals or plants which used to live in your area, but no longer do.

Describe the changes that seem most responsible for eliminating each of these plants or animals.

Suggest and evaluate the advantages and disadvantages, if any, of possible actions that could have been taken to prevent the elimination of these plants or animals from the area.

Name one kind of wildlife that would do better, and one kind of wildlife that would do worse, in areas in which humans cut down a forest and planted grass; dammed a creek to flood a valley; put in a housing development with large lawns and many shrubs; built a city on a lakeshore with crowded skyscrapers.

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TRASH - WHAT'S THE PROBLEM?

Suppose that the next time you are asked to take out the garbage, you carry it to a pile in the corner of the yard. Imagine tomorrow's garbage tossed on top of the pile. Try to picture what would happen in a week, a month or even a year. Suppose you had to dispose of your broken television or rusty car on that same pile. You wouldn't have much of a yard left. You'd have a dump!

Many years ago, people chose a place on their land for disposal of items they could no longer use. A muck heap or home dump took care of all of the waste. Later, more people moved in, homes were closer together, and consumers threw away more and more. Soon, home dumps didn't make sense anymore.

Towns and cities began to pick up the waste and haul it in trucks to one big dump. Some communities were so far away that their garbage trucks had to stop at a transfer station. There, trash from several trucks was packed into one big truck which then traveled to the dump. This kept the backyards clean, but it made a huge mess at the dump. Horrible smells, rodents, insects and just sheer ugliness resulted. Burning the refuse polluted the air. Rain washed harmful contaminants into the ground. Town dumps were not a good answer to the growing trash problem.

Landfills are the present trash solution. Trucks bring the waste to the landfill. Each truck is weighed and the town pays for each ton of waste. Then the truck drives to the working face of the landfill and dumps its load of garbage. The garbage is spread several feet deep, then packed down by heavy machines. Each day, the open site is covered with six inches of clean soil. This speeds decay and protects us from health hazards. A huge amount of valuable topsoil is used. Landfill machinery makes noise and dust. The steady stream of garbage trucks may cause problems for landfill neighbors. In spite of careful planning, some wastes may ruin our water supply. To be sure that hazardous wastes do not leach into the groundwater, we need special, sealed landfills.

Landfills alone can't deal with the five pounds of waste each person in the United States creates daily. We must reduce the amount of waste we produce. We'll need new methods like recycling and resource recovery to help. The final solution to the trash problem has still not been found.

TREE AMIGOS

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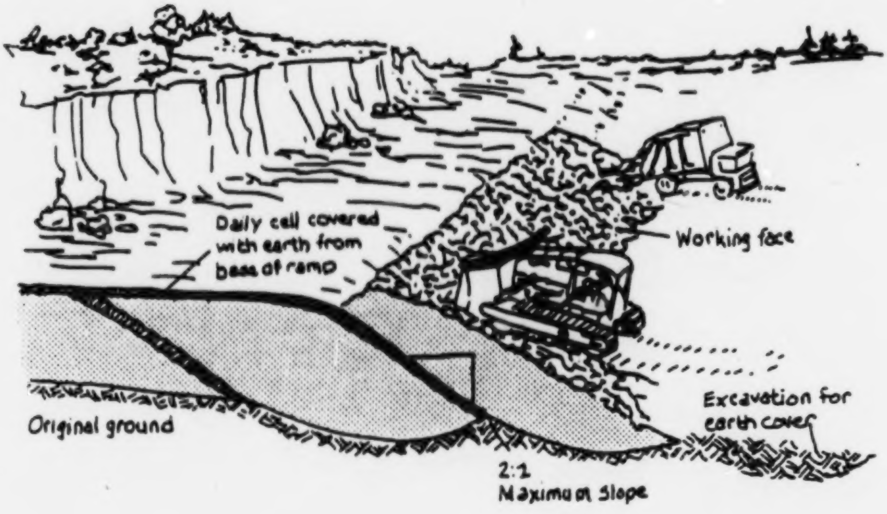
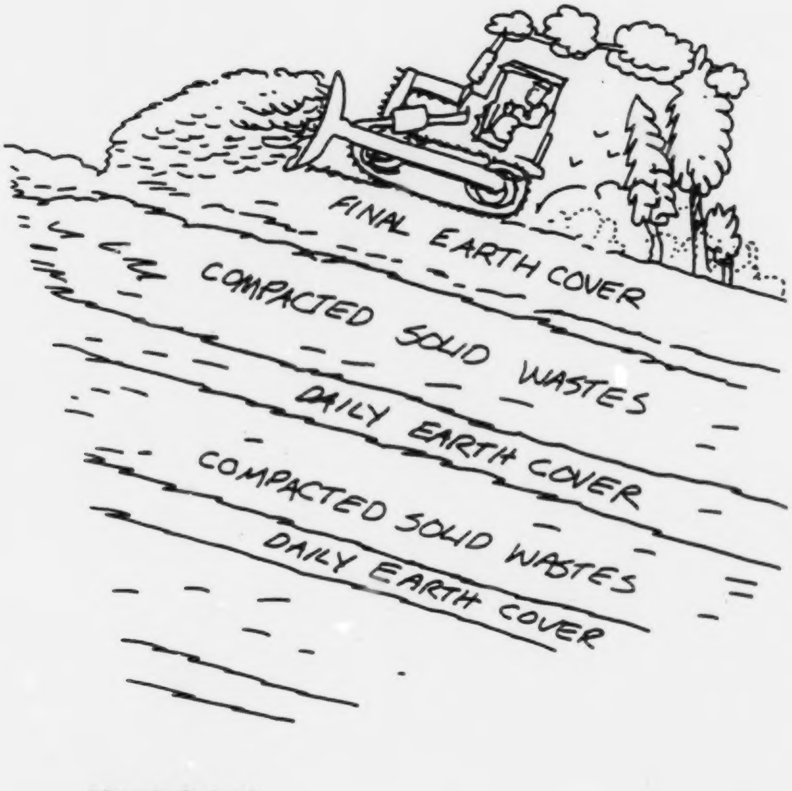

Daily cell covered with earth from base of ramp
Working face
Original ground
Excavation for earth cover
2:1 Maximum Slope


FINAL EARTH COVER
COMPACTED SOLID WASTES
DAILY EARTH COVER
COMPACTED SOLID WASTES
DAILY EARTH COVER

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WORDSEARCH...BURIED TRASH

Eighteen important words from "Trash – What's the Problem?" are hidden in this wordsearch. Find and circle 12 vertical and 5 horizontal words. List them on the back of the paper. Be sure you know what they mean!

Y	U	X	T	Z	J	S	C	Z	K	N	T	Y	E
K	W	A	M	T	P	O	O	R	S	O	R	L	O
C	B	D	H	L	O	I	N	N	N	Z	A	D	Q
W	H	J	D	T	R	A	S	H	Z	P	N	M	L
H	A	Z	A	R	D	O	U	S	W	A	S	T	E
T	R	C	U	B	Z	E	M	M	X	Y	F	E	A
R	M	R	I	D	S	E	E	V	F	A	E	B	C
A	F	E	P	Q	F	G	R	E	V	Z	R	L	H
N	U	S	D	U	M	P	S	L	M	B	S	N	C
C	L	O	E	G	Z	O	U	N	P	G	T	A	D
A	A	U	C	R	B	K	G	A	R	B	A	G	E
F	Z	R	A	J	Y	B	Z	R	E	I	T	R	M
F	C	C	Y	S	Z	T	H	C	F	Y	I	O	B
T	R	E	R	Q	I	H	F	O	U	J	O	U	D
V	X	R	E	W	K	V	I	N	S	K	N	N	G
X	D	E	C	J	N	S	I	T	E	P	T	D	L
V	G	C	Y	E	S	U	E	A	C	O	O	W	S
M	J	O	C	W	H	A	I	M	F	L	P	A	V
U	W	V	L	A	N	D	F	I	L	L	S	T	J
Y	H	E	I	N	K	T	Q	N	P	U	O	E	O
A	Z	R	N	C	X	V	G	A	S	T	I	R	R
W	A	Y	G	B	D	I	T	N	U	E	L	C	T
H	E	J	X	W	E	V	G	T	F	D	K	N	Z
Z	Y	A	D	C	B	M	U	S	R	P	S	L	O

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MINI LANDFILL
Science Activity

Students will understand the process of decomposition in a landfill. Students will learn which items are biodegradable and which will not deteriorate over time.

MATERIALS NEEDED

Two identical pieces of each of the following: food scraps, newspaper, cardboard, glass, cloth, aluminum foil, plastics, copper wire etc., a cardboard shoe box, a piece of foil or plastic to line the box, toothpicks, string, masking tape, index cards or small cardboard squares, water, student worksheet (one per student)

IMPLEMENTATION

Explain to students that landfills not only hold our waste, but that the process of covering the garbage with soil actually contributes to breaking it down into smaller and smaller pieces. But only certain materials will decay. Building a mini landfill provides an opportunity for students to hypothesize about what kinds of materials will break down over time and then determine the accuracy of their predictions.

Have students construct a mini landfill by lining the shoe box with aluminum foil or plastic. Fill the box half-full with earth. (NOTE – DO NOT USE POTTING SOIL – it has been sterilized and does not contain the microorganisms which are essential to the process!) Bury two identical rows of waste, marking the location of each item with cardboard labels on string or toothpicks. Students may prepare one mini-landfill as a class project; several, in small groups; or individual projects.

On the worksheet, note the date and items placed into the landfill. Add water to moisten the soil, then place the mini landfill in a sunny spot. Water the landfill regularly, keeping the soil moist, but not wet. Wait 10 days before continuing with the second phase of the project.

After 10 days, carefully remove the waste items from one row of the landfill and examine them. A magnifying glass may be helpful at this point. Individually, or as a class, answer the questions on the student worksheet.

Wait 10 more days and repeat for the second row of waste materials. Mini landfill discussion questions may be discussed orally or prepared individually for comparative purposes.

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EXTENSION

Choose an area of the ground outside which is shady yet near small plants or grasses, or encourage students to conduct this experiment at home and report results to the class. Impale an apple onto a stick so that it cannot be carried away by animals. Observe it day by day and keep a record of what happens. This may be done in illustrative form. Keep track of: the first signs that something has been eating it, the first break in the skin, the first indication of decay odors, the appearance of insects or worms and where they come from, the appearance of molds or fungi. The record will indicate how many days it takes the apple to almost disappear and how many different agents worked on the cleanup job.

VOCABULARY

biodegradable
leachate
organic
microorganisms
decay
bacteria
sterilized
decomposition

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MINI LANDFILL WORKSHEET
week 1

1. The items which decomposed the most are:

____

____

____

____

2. The following items decomposed a little:

____

____

____

____

3. These did not change at all:

____

____

____

____

4. Why do you think some items are decomposing more quickly than others?

____

____

____

____

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MINI LANDFILL WORKSHEET

week 2

1. The items which decomposed the most are:

____

____

____

____

2. The following items decomposed a little:

____

____

____

____

3. These did not change at all:

____

____

____

____

4. What significant changes have you seen since last week?

____

____

____

____

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MINI LANDFILL DISCUSSION QUESTIONS

1. Which items in the mini landfill decomposed the most?

   ____

2. Were the decomposed items manmade or natural?

   ____

3. Were the decomposed items biodegradable? How do you know?

   ____

4. What characteristics are shared by the items which decomposed quickly?

   ____

5. As you have discovered, some items did not decompose in your landfill. Do you think they will remain unchanged for a long time? If your answer is yes, can you tell why?

   ____

6. In what other ways could we dispose of these items?

   ____

7. Did mold form on your landfill? If yes, why did this occur?

   ____

8. What do you think happens to waste left out in the desert?

   ____

9. Suppose that your landfill was made with sterilized potting soil. Would waste have decomposed as quickly? Why?

   ____

10. Did you notice any spaces around the waste items as you dug them up? What caused the space to form? If this happened in a real landfill, how could it affect the future use of the land after the landfill closed?

    ____

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TEACHER'S PAGE

MINI LANDFILL DISCUSSION QUESTIONS

1. Which items in the mini landfill decomposed the most?
LIST WILL VARY

2. Were the decomposed items manmade or natural?
NATURAL

3. Were the decomposed items biodegradable? How do you know?
PROBABLY YES, RAPID DECOMPOSITION, PRESENCE OF MICROORGANISMS

4. What characteristics are shared by the items which decomposed quickly?
ANSWERS WILL VARY THEY ARE NATURAL, ORGANIC ETC.

5. As you have discovered, some items did not decompose in your landfill. Do you think they will remain unchanged for a long time? If your answer is yes, can you tell why?
YES, BECAUSE THEY ARE NOT BIODEGRADABLE, DECOMPOSITION WILL TAKE A VERY LONG TIME.

6. In what other ways could we dispose of these items?
REUSE, RECYCLE

7. Did mold form on your landfill? If yes, why did this occur?
IF YES, BECAUSE OF MOISTURE AND MICROORGANISMS

8. What do you think happens to waste left out in the desert?
IT IS PRESERVED, WITHOUT MOISTURE THERE ARE NO MICROORGANISMS TO PRODUCE DECOMPOSITION

9. Suppose that your landfill was made with sterilized potting soil. Would waste have decomposed as quickly? Why?
NO, STERILIZED SOIL CONTAINS NO MICROORGANISMS

10. Did you notice any spaces around the waste items as you dug them up? What caused the space to form? If this happened in a real landfill, how could it affect the future use of the land after the landfill closed?
DECOMPOSITION IN PLACE, LAND COULD BE UNSTABLE, POTENTIAL FOR COLLAPSE

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EVEN TRASH NEEDS A BREATH OF FRESH AIR!

Science Activity

Students will compare the biological activity in three different waste disposal systems and be able to identify which conditions are conducive to decomposition.

MATERIALS NEEDED

Three wide-mouthed glass jars or beakers, soil, organic wastes, clear plastic wrap, elastic bands, worksheet to record daily observations

IMPLEMENTATION

Tell students that they are going to experiment with three types of waste disposal systems in order to compare how well they work in breaking down biodegradable materials.

Have students prepare the three systems according to the following directions. Encourage them to compare the differences and similarities in the breakdown which occurs.

To represent *open dumping* (aerobic conditions), layer two inches of rich soil in a glass jar. Place several pieces of garbage (orange peel, newspaper scraps, lettuce, egg shells, apple core etc.) on the surface. (NOTE: do not use meat and dairy products, for the sake of avoiding odors in the classroom.) Moisten the soil, cover with clear plastic wrap and seal with a rubber band. Add water as needed to keep the soil moist. Remove the cover every three days for a few minutes to allow air in. Record disintegration and mold formation daily.

To represent a *properly managed landfill* (partially aerobic conditions), set up a second beaker with two inches of soil. Insert several small samples of organic waste, placing them near the outer edge of the container for ease in observation. Cover with two more inches of soil and press down. Cover jar as in the experiment above. Moisten soil as needed. Record observations of decomposition and mold formation.

To demonstrate an *improperly managed landfill* (anaerobic conditions), half fill a third beaker with soil, add samples of organic waste, then add water to within two inches of the top. Stir vigorously, then cover tightly. Observe mixture daily, noting formation of odor and/or gases. (Methane, a product of anaerobic decomposition, will produce an occasional bubble through the water.) Compare the observations with those from the two previous methods.

Which was the most effective environment?

VOCABULARY

aerobic
biodegradable
anaerobic
decomposition

SOURCE

Teaching Resource Recovery in the Classroom

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EVEN TRASH NEEDS A BREATH OF FRESH AIR!
Worksheet

DAY	Open Dump	Proper Landfill	Improper Landfill
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

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Making a Model Landfill*

Goals:

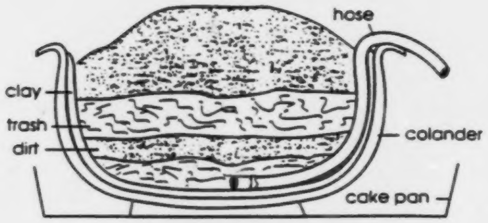
To teach students where their garbage goes and to help them understand the problems associated with garbage disposal.

Grades: 2-3

Background:

Every day, each person in Wisconsin throws away approximately 3.5 pounds of trash. Most people give little thought as to where it goes and what happens to it when it gets there. Where is "away"? In the United States, "away" means a landfill, incinerator, or even the ocean! In Wisconsin, "away" is usually one of the over 200 licensed landfills located throughout the state. Wisconsin use to have over 1,000 dumps and landfills. However, only a small percentage of these were state-of-the-art landfills, designed to prevent pollution problems. With new federal regulations, most of the older dumps and landfills were closed, and Wisconsin residents had fewer places to put their trash. Most people do not know what happens to their trash when it's put in a landfill. Thus, they question the need to close old landfills and resist the construction of new landfills in their community.

This activity will help students understand what happens to their trash. The students will become familiar with the term "leachate"—the liquid that has percolated through trash or been generated by the decomposition of trash in a landfill. It carries dissolved or suspended materials that may contain toxic chemicals which can contaminate ground and surface water. Leachate is one of the major problems associated with landfills.



Materials:

- 2 plastic colanders
- 2 cake pans
- 1 half gallon ice cream bucket of garden soil per colander
- 3 feet of plastic aquarium hose
- 1 rubber band
- small piece of nylon stocking
- small pieces of typical home-generated garbage (see Parent Letter)
- modeling clay
- grass seed
- colored crepe paper
- paper & pencil

Procedure:

1. The day before you teach this lesson, ask your students to bring in five items their family throws away. Send a note (like the one at the end of this lesson plan) home with each student to remind her/him and to request parental assistance.

2. After doing "It's Your Trash" or a similar activity, ask your students the following questions:
    - What happens to your trash after you throw it away?
    - Where is "away"?
    - Has anyone been to any of these "away places"?

Give them ample opportunity to share their ideas and experiences.

3. Tell students that most of the trash in Wisconsin ends up in landfills. Ask them: What happens to trash once it is buried in a landfill? After you discuss some of their answers, ask them to help you build two model landfills. One will be an old fashioned dump, and one will be a modern sanitary landfill.

4. Line one colander with flattened modeling clay. Pat out clay into a thin layer, like a pie crust. This represents the liner of a sanitary landfill. Do not line the second colander. It represents the old fashioned dump where the policy was to dig a hole, dump in the trash, and cover it with dirt.

5. Attach the piece of nylon stocking to one end of the plastic aquarium hose with a rubber band. Put this end in the bottom of the clay lined landfill. This will be your monitoring well. The leachate that collects at the bottom of the clay liner can be siphoned off and examined.

6. Have students cut each different garbage item into small pieces, about two inches square. You will have to cut or break metal, glass, or leather items.

---

*Developed by Mary Snudden, Eau Claire School District, Wisconsin

"K-3 Supplement to the Recycling Study Guide"
Wisconsin Department of Natural
Resources Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

7. Place trash and soil in colanders in alternate layers until they are filled. Keep a list of all items placed in each landfill or keep an example of each piece of trash. You may want to add a layer of colored crepe paper to represent toxic waste (the color leaches out).

8. Build a small mound of dirt in each colander and plant grass seed. Let your students add "match box" garbage trucks, front end loaders, graders, and compactors that might be used at a landfill site. Place cake pans under the colanders to collect the seepage or leachate.

9. Have your students water or "rain" on each landfill twice weekly and observe the changes that are taking place. Pay particular attention to the seepage or leachate accumulation in each cake pan. The seepage from the unlined landfill can be observed as it collects in the bottom of the pan. This observable phenomenon helps children understand how ground water can be contaminated. The lined landfill should not have any seepage. Where did the "rain" water go in this landfill? To find out, you will have to siphon leachate out of the bottom of the clay liner using the "monitoring well". Gently suck on the protruding end of the aquarium hose while keeping this end below the bottom of the clay liner. As the leachate is drawn up the hose and starts down towards your mouth, stop sucking and stick this end of the hose in the cake pan or a glass jar. This should draw off all of the leachate. Observe the leachate and discuss what you have found. Did any "toxics" show up? In modern landfills, leachates are collected and properly disposed of to prevent groundwater contamination.

10. After a period of time (several months*), open each landfill and see how many items you can find and identify. What changes have taken place? What would have happened to the leachate if it was not siphoned off or trapped in the pan?

*Note: Several months may seem like a long time for young children to wait. Put the "opening" date on each landfill and do weekly observations as a "count down" to the "opening"—make it a big event.

Going Beyond:

- Place a small sample of each item landfilled in a jar of water. Have your students observe how water changes or doesn't change things and how things change water.
- Once a landfill is full and officially closed, a clay "cap" is put over it to keep water out. This also effectively seals out air. What will happen to the trash if no water or air can get into the landfill? You may want to add a third colander-landfill with a clay cap to your experiment and observe what changes may take place.
- Put examples of items made from materials used 100 years ago (wood, leather, glass, iron, etc.) and items made from modern materials (plastic, styrofoam, aluminum, etc.) in separate jars of water. Observe what happens over time. What happens to plastics that are dumped in the ocean?
- Fill a glass jar two thirds full of water. Add four drops of red food coloring. Put a stalk of celery into the water. Observe what happens. Do plants filter pollutants out of water?

Parent Letter:

Dear Parent,

Tomorrow we will begin learning about landfills in class, and we need examples of items that families throw away. I have asked each child to bring in five small examples of household trash. Please help your child collect items from the following list:

- all types of paper items
- all types of plastic or "styrofoam"
- vegetable matter (potato peelings, carrot chunks, grass clippings, etc.)
- animal matter (chicken wing bones—only a small amount)
- broken small toys—"match box" car pieces (metal, tires, windshields, etc.)
- aluminum foil
- other—use your imagination

Put the items in a small plastic bag and send them to school with her/him tomorrow. Thank you for your help.

Sincerely,

"K-3 Supplement to the Recycling Study Guide"
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Madison, WI 53707

LEARNING ACTIVITIES

PEOPLE & RESOURCES

PEOPLE AND RESOURCES CONCEPTS

POPULATION

NATURAL RESOURCES

RESOURCE CONSUMPTION

RESOURCE DEPLETION

RENEWABLE AND NON-RENEWABLE RESOURCES

The Lorax*

Age: 8-14 years old

Goals: To help children understand human impacts on natural systems and the environmental impacts of a consuming society.

Background:

The Lorax, a children's book by Dr. Seuss, tells of the deterioration of an environment because of reckless exploitation of "truffula trees" to produce "thneeds" to meet the incessant demands of consumers. It could very well portray our society's demands for consumer goods. In fact we exploited our resources the very same way in the United States 100 years ago. Fortunately, through individual efforts and environmentally sound legislation, many of our resources are being better managed today than the "truffula trees" were. However, our demand for consumer goods is still very high and many of our resources are still being thrown away after use instead of being recycled or reused. Our consumer demands still cause resources to be exploited in other countries that do not have the strong environmental laws that we have.

Our forests are a good example of a resource that we once exploited but now manage quite well for sustained yield. Wildlife, soil and water are also given consideration in our forest management plans. The rain forests in other countries are still being exploited, partially as a result of our demands for consumer goods.

Materials:

a copy of The Lorax by Dr. Seuss

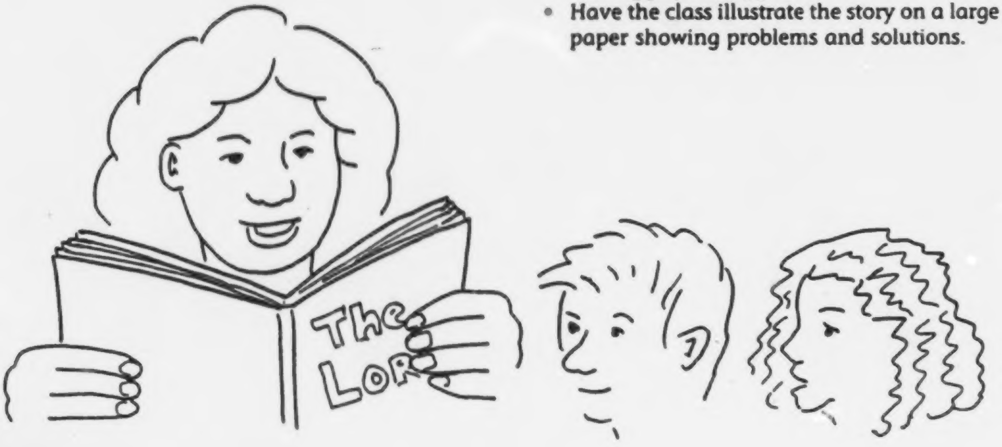
Procedure:

1. Read The Lorax to your group.
2. Discuss the following questions:
- What happened to the "truffula trees"?
- What happened to the "brown bar-ba-loots"?
- What was made from the "truffula trees"?
- A "thneed" is defined as a fine thing that everyone thinks they need. What are examples of "thneeds" — things that we think we need?
- How could the "once-lers" have made "thneeds" without destroying all of the "truffula trees"?
- If you were the "once-ler", what would you have done differently to protect the environment?
- What can we do today to protect the environment?

3. Make sure that the children leave with the knowledge that we must harvest resources in order to keep on living. The key is to manage and harvest our resources wisely and to get the most use out of any resource that we utilize. Reducing consumption, reusing materials and recycling resources are some of the ways that each of us can help.

Going Beyond:

- Identify real-life examples of the following items in the story: "swomee-swans", "truffula-trees", "brown-bar-ba-loots", "humming fish", "thneeds", "once-lers", "smogulous smoke", "gluppity-glup", and "schloppity-schlopp".
- Have the class illustrate the story on a large piece of paper showing problems and solutions.



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Jungle in the Pantry

Search for household items that come from tropical forests, and then research their origins.

Objective:
Name some common products that originated in tropical forests.

Ages:
Intermediate and Advanced

Materials:
- *copies of page 46*
- *reference books*
- *paper and pencils*

Subjects:
Science and Social Studies

You may have heard the expression, "It's a jungle out there!" But you may not realize that there's probably a "jungle" in your own home too. Many of the products that we use every day have their origins in tropical forests.

In this two-part activity, your group will have a chance to discover which of these products are in their own homes. Then they'll do some research to find out more about where these products come from. But before you start, copy each of the products listed in the margin onto a slip of paper and put the slips aside.

PART 1: JUNGLE PRODUCT SURVEY

Begin this part of the activity by going over what tropical rain forests are and where they're located, using the background information on pages 3–5 and the map on pages 18 and 19. Then ask the kids if they can think of anything they use that might have come from a tropical rain forest. Tell them that many of the things we use every day originated in tropical forests. You may want to bring in samples of some of the products listed on page 46.

Pass out a copy of page 46 to each person and go over the product lists. Explain that all the products on the page originated in tropical forests. (*Note:* Most of these products originated in tropical rain forests, but we have included several important products—marked with an asterisk—that may have gotten their start in other types of tropical habitats near rain forests. And the plants these products originated from could be affected by the destruction of rain forests.)

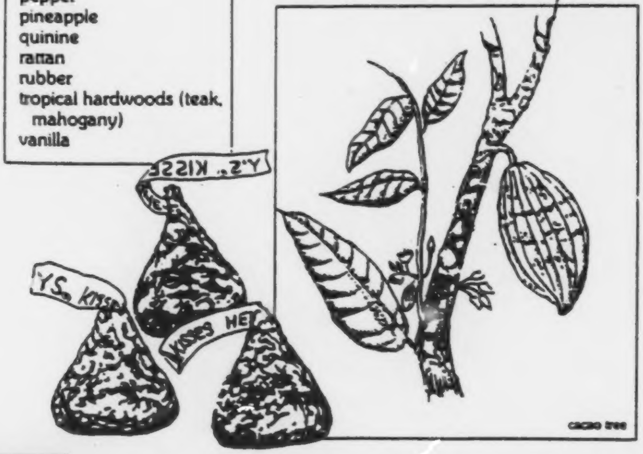
Next use the information under "Tropical Wealth" on the next page to describe the general types of products that have come from tropical forests. Then have the kids take their lists home and work with their parents to see how many of the products they can find. Tell them to check off each item they find. (Also have them circle items they know they've had in the house before, but currently don't have.) The items in parentheses should give the kids some ideas of where to look.

When the kids return with their completed checklists, use the results and the background information on page 36 to discuss the importance of tropical rain forests in our daily lives. Explain that many of the products on the list, such as citrus fruits, are now cultivated and harvested in other parts of the world. And, in some cases, synthetic alternatives, such as artificial flavors and synthetic rubber, have been developed to replace certain jungle products.

But some of the products still come directly from tropical forests. Mention that the demand for some of these products, such as tropical hardwoods, has contributed to the destruction of tropical rain forests. Explain that for people to continue to enjoy and benefit from tropical resources, we must harvest them carefully and use them wisely. Unless people protect tropical forest ecosystems, we may never know about many other potential products. (For more about the problems of tropical deforestation, see chapter 4.)

TROPICAL PRODUCTS

- bamboo
- banana
- chicle (chewing gum)
- chocolate
- coconut
- coffee
- cola (kola nut)
- curare
- jute
- orange
- pepper
- pineapple
- quinine
- rattan
- rubber
- tropical hardwoods (teak, mahogany)
- vanilla



cacao tree

"Tropical Treasures" Ranger Rick's Nature Scope
National Wildlife Federation
1400 Sixteenth St. NW
Washington, DC 20077

COPYCAT PAGE

JUNGLE IN THE PANTRY.

WOODS, CANES, AND FIBERS

Woods

(furniture, floors, doors, paneling, cabinets, carvings, toys, models)

___ balsa
___ mahogany
___ rosewood
___ sandalwood
___ teak*

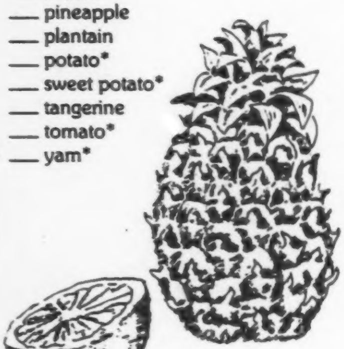
Canes and Fibers

___ bamboo (cane furniture, crafts)
___ jute* (rope, twine, burlap)
___ kapok (insulation, stuffing)
___ ramie* (knit materials)
___ rattan (furniture, wicker, cane chair seats)

FOOD PRODUCTS

Fruits and Vegetables

___ avocado
___ banana
___ grapefruit
___ guava
___ heart of palm
___ lemon
___ lime
___ mango
___ orange
___ papaya
___ passion fruit
___ pepper
___ pineapple
___ plantain
___ potato*
___ sweet potato*
___ tangerine
___ tomato*
___ yam*



Spices and Flavors

___ allspice
___ black pepper
___ cardamom
___ cayenne (red pepper)
___ chili pepper
___ chocolate or cocoa
___ cinnamon
___ cloves
___ ginger
___ mace
___ nutmeg
___ paprika
___ turmeric
___ vanilla

Other Food Products

___ Brazil nuts
___ cashew nuts
___ coconut
___ coffee
___ cola
___ corn*
___ macadamia nuts
___ peanuts*
___ rice*
___ sesame seeds*
___ sugar*
___ tapioca
___ tea

HOUSEHOLD PRODUCTS

Houseplants

___ African violet
___ aluminum plant
___ *Begonia*
___ bird's-nest fern
___ bromeliads
___ Christmas cactus
___ *Croton*
___ *Dracaena*
___ dumb cane (*Dieffenbachia*)
___ fiddle-leaf fig
___ kentia palm
___ orchids
___ *Philodendron*
___ prayer plant
___ rubber plant
___ snake plant (*Sansevieria*)
___ spathe lily
___ swiss-cheese plant
___ umbrella tree (*Schefflera*)
___ zebra plant (*Aphelandra*)

Oils

___ bay (bay rum lotion)
___ camphor (insect repellent, medicine)
___ coconut (snack food, baked goods, lotions, soap)
___ lime (food flavoring, candles, soap, bath oil)
___ palm (snack food, baked goods)
___ patchouli (perfume, soap)
___ rosewood (perfume)
___ sandalwood (soap, candles, perfume)

Gums and Resins

___ chicle (chewing gum)
___ copal (varnish, printing ink)
___ dammar (varnish, lacquer)
___ rubber (balloons, erasers, foam rubber, balls, rubber bands, rubber cement, gloves, hoses, shoes, tires)

* products that may have originated in other types of tropical habitats near rain forests

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GOING TO MAKE THIS GARDEN GROW . . .

Science Activity

Students will demonstrate the effects of different soils on plant growth and observe that compost can be used as soil and in students' gardens at home.

MATERIALS NEEDED

Soil samples (clay, sand, compost, schoolyard soil, commercial potting soil), containers for soil samples and planting seeds (milk cartons etc.), seeds (marigolds, tomatoes or beans work well), plastic wrap, student worksheet (one per student)

IMPLEMENTATION

Help students prepare two identical series of soil samples, using milk cartons or paper cups as containers. Label each container: clay, sand, schoolyard soil etc.

Ask students if they think that adding compost to the soil samples in one set will help the plants to grow better. Record their predictions. Measure and add an equal amount of compost to each soil sample in one set and mix. Label this Set A. Label the plain soils Set B.

Have students plant the same type of seed in each soil sample in both sets. Water, then cover the containers with plastic wrap (to keep seeds moist) until sprouts appear.

Have students complete the chart to compare the soil samples. Discuss results, including growth and appearance. Compare results with predictions

Discuss:

- is soil type important for good plant growth?
- does compost help plant growth?
- can people help their lawns, trees, and gardens by putting compost around them?

EXTENSION

Ask the students to find out:

- the size of their lawn and backyard.
- if their parents rake leaves and grass.
- what their parents do with the raked leaves and grass.
- how long it takes to put a pile of leaves into a bag.

Explain to students that they can make a compost pile in the backyard just like they made in the classroom, using the discarded leaves. Give each student a pamphlet and encourage them to share the information with their parents. If students do begin compost piles at home, encourage them to bring in samples of their finished soil from time to time, for comparative purposes.

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NAME ______________________

SET A	first growth	height day 2	height day 3	height day 4	height day 5	height day 6	height day 7	height day 8	height day 9	Observations
CLAY										
SAND										
COMPOST										
SCHOOL SOIL										
POTTING SOIL										
SET B										
CLAY										
SAND										
COMPOST										
SCHOOL SOIL										
POTTING SOIL										

"Oscar's Options"
83 Park St
Providence, RI 02903

Greenhouse Gardens

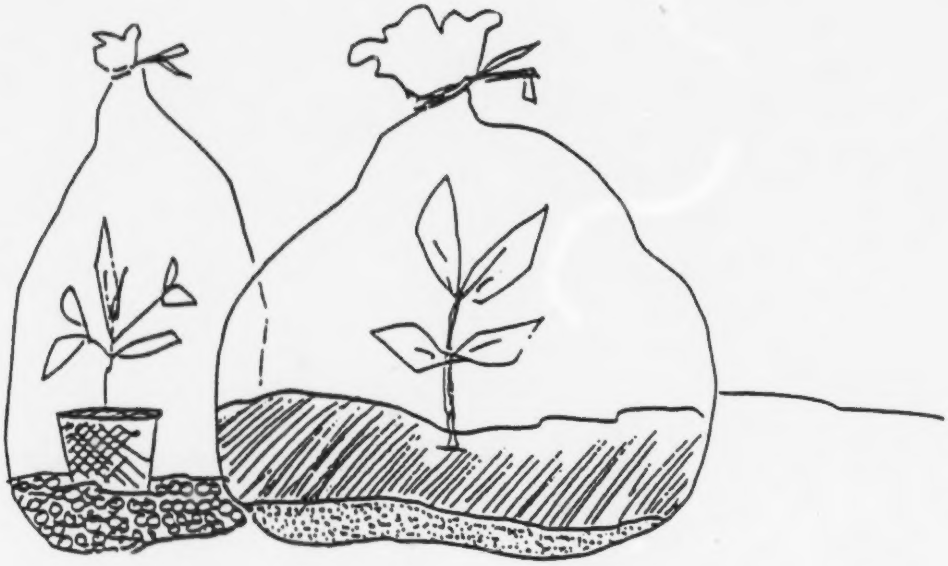
If you have a plastic bag, you can have your own individual greenhouse.

Here's what you need:

A plastic bag, a quart size is good.
Planter mix
A peat pot (any kind of container will work, but you can plant the peat pot later)
Pebbles or a little sand for drainage
Water
A plant cutting

Here's what to do:

1. Put a little sand or a few pebbles in the bottom of the plastic bag.
2. Fill the peat pot (or container) with planter mix.
3. Carefully plant the cutting.
4. Add water so that the planting mix is moist.
5. Put the pot in the plastic bag. Tie the top of the bag closed with a rubber band or the twist type bands that come with purchased plastic bags.
6. Set the closed greenhouse in a place where it will get light but not direct sun.



"Reduce, Reuse, & Recycle Activities For All Grades"
Waste Education Clearinghouse
Office of Waste Managment
1350 Energy Lane
St. Paul, MN 55108

Sponge Gardens

Materials Needed:

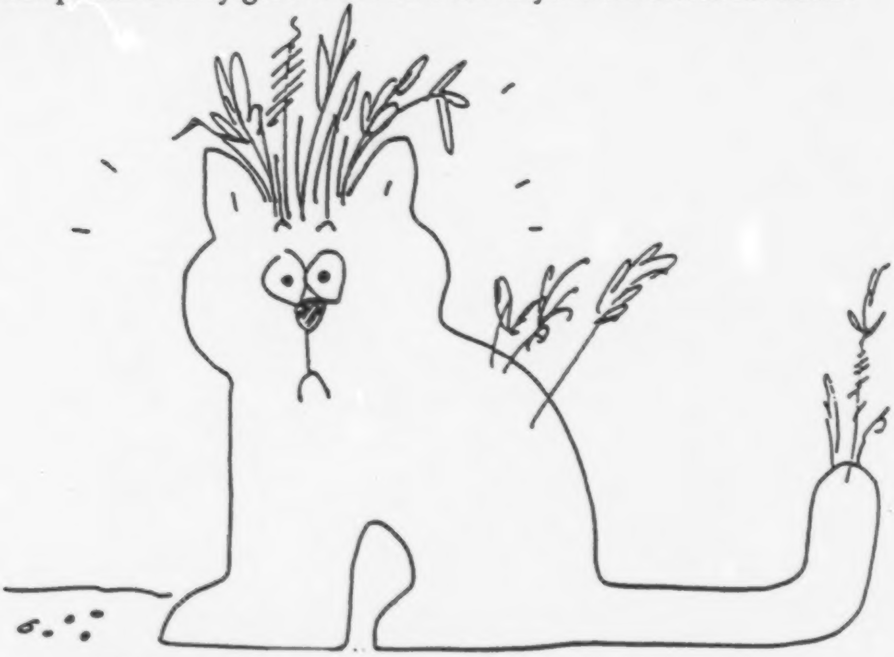
- A flat, thin sponge
- Water cress seeds (or mustard)
- Aluminum pie plate
- Water
- Scissors

Directions:

1. cut sponge into animal or tree shape. (Left over pieces of sponge are great for sponge painting or crystal gardens.)
2. Put sponge shaped in pie plate ad add water.
3. Sprinkle seeds on top of sponge.
4. Add water to keep sponge moist.

Seeds will sprout to form fuzzy green hair for your animal or pretty green leaves for your tree.

Snip off the green plants as they grow and add them to your sandwich for lunch.



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Growing Plants - Eggheads

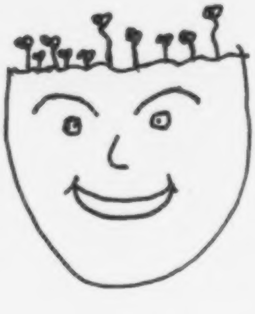
Growing sprouts (bean, grass, bird seed, etc.) is a fast method of helping children to understand that all plants need water to grow.

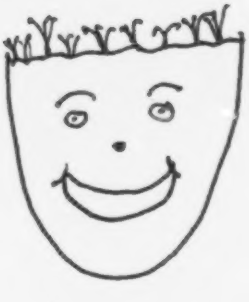
Making eggheads adds a little fun and excitement to the process. Here's what to do.

Have the children bring in egg shells that are 3/4 whole. Have extras on hand as some will surely break during the decorating session Make faces on the shells with felt tip pens or poster paint, keeping the open end up. When the faces dry, carefully fill the shells with planting mix. It should go all the way to the tip edges of the shell. Sprinkle grass seed evenly over the surface and pat gently into the soil. Water them carefully but generously. Put your eggheads in a carton and place them by a sunny window.

Before long, every baldy will be sporting a crop of healthy, green hair.

For extras you can use paper tubes from bathroom tissue or paper towels to make individual holders. Children can decorate the tubes with collars, ties, shirts, jewelry or whatever they choose.





Music - "It's A Small World"

Learn the son "It's A Small World" by Sherman and Sherman, Walt Disney, Inc.

Then sing these additional verses by Mary Hallesy and the 1976 LeCone Lodge Summer Staff.

1. There is just so much water and so much air
And just so much land and food everywhere
There's so much we must share, oh it's time we're aware
It's a small world after all. (Chorus)

2. So many people using up so much so fast
We cannot go on as we've done in the past
It is time to confess we have got to USE LESS
It's a small world after all. (Chorus)

3. On this spaceship earth we are all a crew
And we've got to learn what we must do
It is time we're aware we use more than our share
It's a small world after all ! (Chorus)

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Where Do Things Come From?

Age: 8-12 years old

Goals: To help children learn where our products come from and the difference between renewable and nonrenewable resources.

Background:

In order for people to understand the need for recycling, they must have an understanding of the source of the products they use and that the earth has a limited supply of resources. All of the materials that make up our goods and products are derived from the earth's natural resources. Some of our resources are quite abundant like sand and grass, but some are scarce like oil and diamonds. Some of our resources are renewable (can be replaced in a relatively short period of time) and some are nonrenewable (once taken out of the earth no more will take their place for a long, long time). For this activity all of earth's resources (excluding water and air) can be lumped into five categories—Rocks, Minerals, Petroleum/Oil, Plants, and Animals.

Materials:

copies of Resources Scavenger Hunt Worksheet (page 15)
clipboards
pencils
examples from each of the five resource categories listed above

Procedure:

1. Ask the children, "Where do things come from?" Discuss the earth's resources and identify the five categories. Show specific examples of products derived from each category and ask the children for other examples. Talk about renewable and nonrenewable resources. Ask the children for specific examples of each.

2. Pass out the scavenger hunt sheets, clipboards and pencils. Give them the following directions:

- Find 15 of the 30 items on the list. These should include at least three items from each of the five categories.
- Indicate items found with a check in front of the item.

Do not collect the items and bring them back!

- Identify which resource category the item belongs in by putting an R for rocks, M for mineral, O for oil, P for plant, and A for animal on the line behind it.
- Finally, circle the renewable resources.
- Extra points will be given for the special items listed and found. Explain that "nature's" packaging means a shell, cone or pod casing.

3. Give the children 15 minutes to hunt for items outside.

4. Call them together and go over the answers. Discuss recycling, reusing, and reducing and how these practices help conserve our resources.

Items by Category — Answers

Rocks	Minerals	Oil	Plant	Animal
glass	penny	plastic bag	charcoal	hamburger
stone wall	pop can	frisbee	bread	ice cream
pottery	diamond ring	nylon sock	lettuce	butter
cement	nail	plastic bottle	firewood	egg
stone building	pencil lead	polyester pants	paper	leather shoes

All items in plant and animal categories are renewable resources.

TREE AMIGOS

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Resources Scavenger Hunt Worksheet

Find 15 of the 30 items listed below. These should include at least three items from each of these categories: Rocks, Minerals, Oil, Plants and Animals.

Indicate items found with a check in front of the item.

Do not try to collect the items and bring them back!

Identify which resource category the item belongs in by putting an R for rocks, M for mineral, O for oil, P for plant, and A for animal on the line behind it.

Circle the renewable resources.

☐ glass ___

☐ frisbee ___

☐ bread ___

☐ pottery ___

☐ butter ___

☐ penny ___

☐ egg ___

☐ nail ___

☐ hamburger ___

☐ ice cream ___

☐ pop can ___

☐ stone wall ___

☐ firewood ___

☐ nylon sock ___

☐ pencil lead ___

☐ lettuce ___

☐ cement ___

☐ plastic bag ___

☐ charcoal ___

☐ paper ___

☐ diamond ring ___

☐ stone building ___

☐ plastic bottle ___

☐ leather shoes ___

☐ polyester pants ___

Extra Credit

☐ returnable bottle ___

☐ "natures" packaging ___

☐ man-made packaging ___

☐ an item that can be used for something else ___

☐ an item made from more than one material ___

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TITLE SHOP TO STOP WASTE

SUBJECTS Home Economics. Consumer Education. Health

OBJECTIVE To recognize ways wastes is generated in the home and develop methods of eliminating or decreasing this waste.

TIME FRAME 1-2 Weeks (Final report may be given four weeks after beginning *5.)

ACTIVITY

1. Students will list waste materials. (See background information objective *2.)
2. Students will describe how their family generates waste, stating approximately how much waste is accumulated in one week, noting waste materials which could be recycled. (Use inventory sheet to record types and amounts of discarded material.)
3. Students will survey their homes (cupboards, refrigerator, closets) for packaging and products made from recycled materials.*
4. Students will develop methods for decreasing or even eliminating home waste. (This can be accomplished through reusing the waste in another manner (use milk carton for bird feeder, etc.), taking the material to a recycling center, using paper products for kindling in fireplaces or woodstoves, etc.)
5. Students will develop a list of products they can buy which are packaged or made of recycled materials.
6. Students will practice the above methods and use the list, comparing the amount of waste, recycled and recyclable materials in their home at the beginning of the project with the amount 2-4 weeks later.

MATERIALS

List of waste materials.
Home inventory handout.
Copy of "Products Using Recycled Paperboard Packaging"
(Attached List).

REFERENCES

Environmental Awareness Shopping Campaign Packet. 645 Madison Avenue, 9th Floor, New York, New York 20022. Carolyn Consor (212) 593-1914.

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Simmons, Ian Gorden: *The Ecology of Natural Resources*: London: Edward Arnold, 1974.

OPTIONAL ACTIVITIES

Follow *Environmental Awareness Shopping Campaign* guideline, posting signs and tags in stores and on shelves where recycled materials have been used.
Present successful methods of reusing materials and eliminating home litter to community groups and organizations. Include costs and resources saved.
Change Home Inventory Sheet to School Inventory Sheet, assigning various areas around the school to students, changing home to school in activity steps.

***IDENTIFYING RECYCLED MATERIALS**

1. Labeled as recycled with symbol or words
2. Inside of cardboard boxes are gray (cracker boxes, etc.)
3. Rough textured paper (paper egg cartons, paper towels)
4. Packaging can be returned for deposit refund

"Looking Good in Ohio Schools"
Ohio Department of Natural Resources
Office of Litter Control
1855 Fountain Square Ct
Columbus, OH 43224

BEST COPY AVAILABLE

SHOP TO STOP WASTE
HOME INVENTORY SHEET

Date	Location	Material	Amount	Recyclable
example Mon. 10-8	Kitchen	Foil	¼ lb.	Yes

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TREE AMIGOS

Products Using Recycled Paperboard Packaging

Cakes, Cookies & Snacks

Nabisco:
Ritz
Sociables
Triscuits
Animal Crackers
Waverly Wafers
Ginger Snaps
Graham Crackers
Vanilla Wafers
Oreos

Uneeda Biscuits
Social Teas
Lorna Doones
Oysterettes
Wheat Thins
Fig Newtons
Cheese Tid-Bits
Vegetable Thins
Cracker Meal

Honey Maid Graham Crackers
Graham Cracker Crumbs
Premium Saltine Crackers
Mister Salty Veri-Thin Pretzels
French Onion Crackers
Buttery Flavored Sesame Cracker
Sesame Wheat Crackers
Mister Salty Dutch Pretzels
Cheese Nips

Keebler:
Sesame Toast
Pumpernickel Toast
Rye Toast

Club Crackers
Town House Crackers
Zesta Saltines

Vanilla Wafers
Honey Grahams
Cinnamon Crisp

Cereals & Breakfast Foods

RTE's
General Mills
Kelloggs
Quaker
Post

Cooked
Maypo
Quick Quaker Oats
Quick Cream of Wheat
Ralston Purina
Wheatena
Pillsbury Farina

Others
Kellogg Pop Tarts
Toastettes
Breakfast Squares

Mixes (Cakes, Cookies, etc.)

Aunt Jemima
ty Crocker
Duncan Hines
Dromedary

Nestle Cookie Mix
Durkee Q-T Frosting Mix
Presto Cake Flour
Swans Down Cake Flour

Pillsbury Plus Cake Mix
Pillsbury Hungry Jack Pancake
Pillsbury Hot Roll Mix
Bisquick Buttermilk Baking Mix

Detergents, Bleaches, Soap Pads, Pre-soaks

Dash
Cheer
Punch
Rinso
All
Fels
Tide
Finish
20 Mule Team Borax
Rescue II Soap Pads
In France Whitener Brightener

Bold
Gain
Fab
Duz
Ajax
Axion
Biz
Calgonite
S.O.S. Steel Wool Soap Pads
Arm & Hammer Laundry Detergent
Borateem

Miracle White
Ivory Snow
Cold Power XE
Snowy Bleach
Clorox
Cascade
Electra Sol
Spic N' Span
Brillo Steel Wool Soap Pads
Arm & Hammer Washing Soda

Pastas, Rice, Potatoes, "Dinners"

Buitoni
Ronzoni
San Giorgio
Uncle Ben's Rice Products
Golden Grain Rice-A-Roni

Success Rice
Carolina Rice
Kraft Dinners (same)
Noodles Romanoff
Mug o' Lunch

French's Idaho Mashed Potatoes
Betty Crocker Hamburger Helper
Betty Crocker Tuna Helper
Betty Crocker Dry Potatoe Product
Minute Rice

Paper & Wrap Products

Kleenex Tissues & Napkins
Scotties & Scotkins
Saran Wrap
Glad Wrap
Handi Wrap

Glad Plastic Straws
Glad Sandwich Bags
Diamond Aluminum Foil
Hudson Table Napkins
Scott's Freezer Tape

Scott Cut-Rite Wax-Sandwich Bags
Reynolds Wrap Aluminum Foil
Marcal Kitchen Charm Waxed Paper
Marcal Fluff Out Tissues
Glad Trash & Garbage Bags

Pet Foods

9 Lives
Purina
Friskies

Gaines
Ken'l Ration

Hartz Mountain
Milk Bone

Drug Items & Miscellaneous

Gleem
Redbow Fancy Lentils
Jello
Crest

Ban
Aim
Redbow Green Split Peas
Stayfree Pads

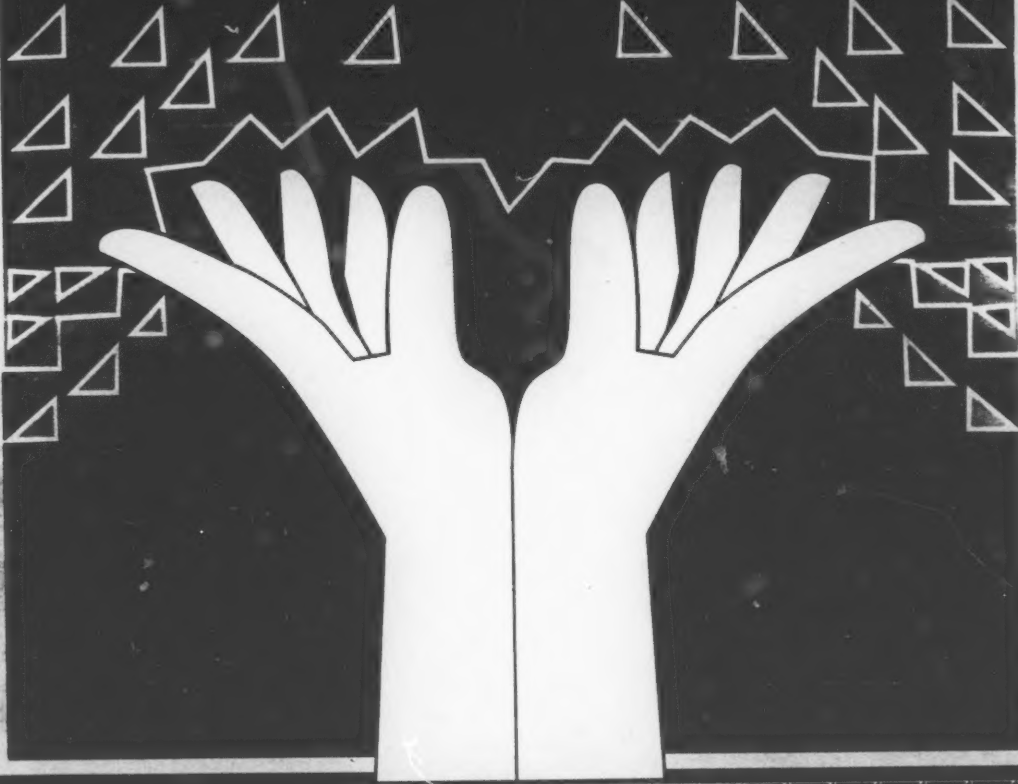
My.T.Fine
Kotex
Arm & Hammer Baking Soda
Knox Gelatin

"Looking Good in Ohio Schools"
Ohio Department of Natural Resources
Office of Litter Control
1855 Fountain Square Ct
Columbus, OH 43224

TREE AMIGOS

LEARNING ACTIVITIES

REDUCE, REUSE & RECYCLE



REDUCE, REUSE AND RECYCLE CONCEPTS

SOLID WASTE CYCLE

POLLUTION

TYPES OF WASTE

CONSUMPTION PATTERNS

CHOICES AND ACTIONS

LIFE STYLE COMPARISONS

CONSUMERS, PRODUCERS AND DISPOSERS

RECYCLING

ECONOMICS OF WASTE

PROBLEM SOLVING

TRASH-A BIG PROBLEM

Social Studies Activity

Students will understand the sources, content and magnitude of the solid waste problem.

MATERIALS NEEDED

Student worksheet (one per student)

IMPLEMENTATION

Distribute "What Do *You* Know About Trash?" and allow time for completion. Use this as an introduction to the topic of solid waste. Share answers with students and have them mark the correct answers on their papers to enable them to share the information with their families.

Further their thinking by asking the extension questions accompanying the answers. Through discussion, share the reasons and implications behind each correct answer. Help students to recognize the underlying causes of the trash explosion (rising population, increased packaging, greater industry, higher personal income etc.).

EXTENSION

Create a Class Trash Book – each student is assigned a letter of the alphabet to create one page of the book. Each page should contain lists and illustrations of waste items beginning with that letter.

Have students create a bulletin board or posters displaying collages in the form of trash cans. Instruct them to include pictures representing each category of solid waste using the following figures: the family trash can typically includes 16% yard waste, 6% plastic, 15% food waste, 10% metal, 10% glass, 30% paper and 13% miscellaneous rubbish.

Have students conduct a survey concerning planned obsolescence, consumerism and the American lifestyle by creating questions to determine either the age or number of several common household items found in their homes. Combine and average answers to create an overall picture.

VOCABULARY

solid waste
garbage
incinerator
obsolescence
trash
compost
tipping fee
dump
recycle
landfill

TREE AMIGOS

"Oscar's Options"
83 Park St
Providence, RI 02903

WHAT DO *YOU* KNOW ABOUT TRASH?

1. The average family of four creates about _____ pounds of trash each week.

____20 ____150 ____500 ____1000

2. In the past 50 years, the amount of waste discarded per person in the U.S. has ______.

____stayed the same ____doubled
____decreased ____increased 10 times

3. Each day, Americans throw away ______ million pounds of edible food.

____1 ____100 ____400 ____900

4. We send ____ cars to the junkyard each day.

____250 ____1000 ____10,000 ____20,000

5. How many years does the average American own a car?

____1 ____3 ____5 ____10

6. How many TVs are thrown out each year?

____100,000 ____1 million
____5.2 million ____7.6 million

7. What percentage of packaging (boxes, bags, and wrappers) is thrown out right away?

____90% ____75% ____50% ____10%

8. How much paper do Americans use each year?

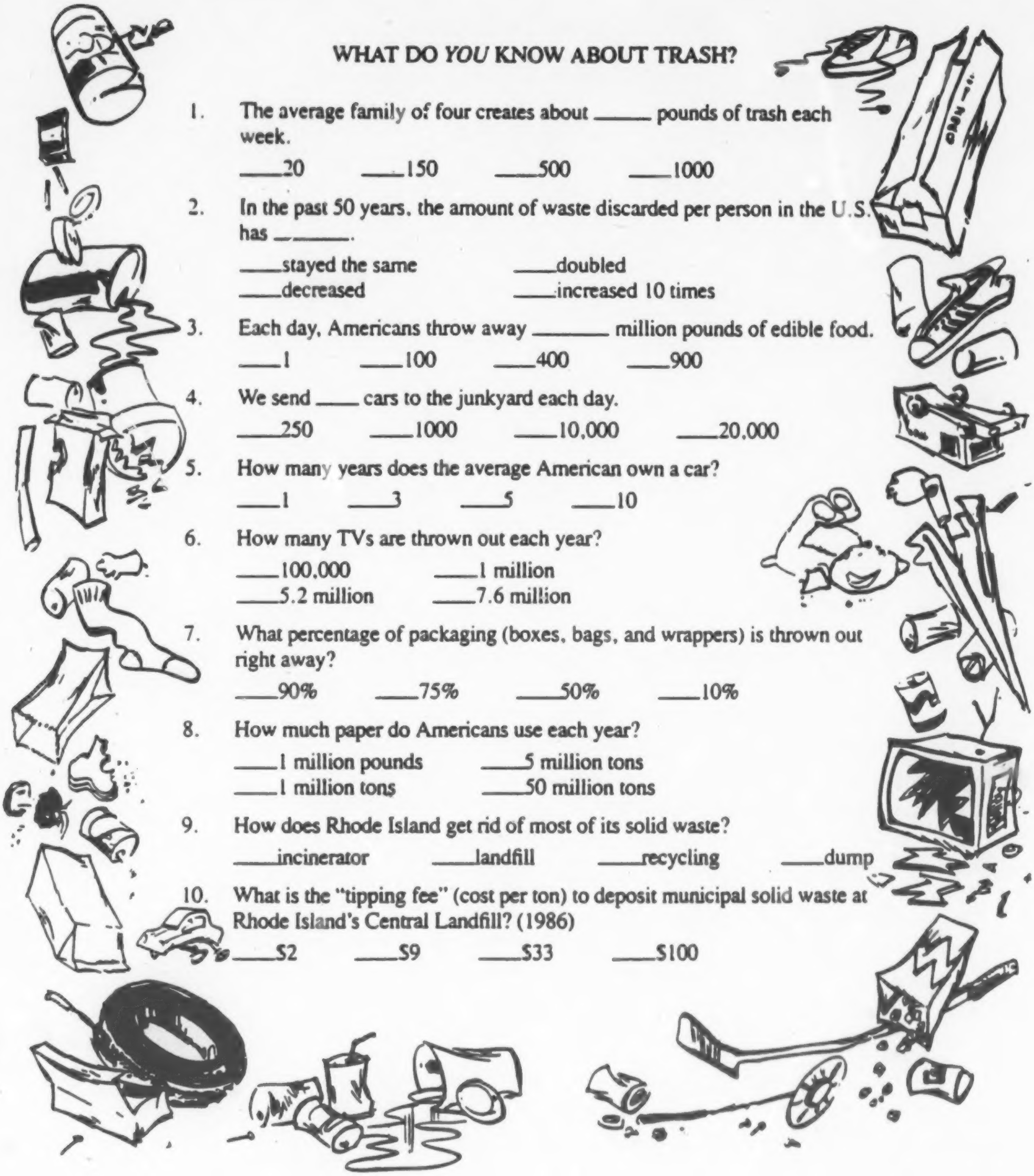
____1 million pounds ____5 million tons
____1 million tons ____50 million tons

9. How does Rhode Island get rid of most of its solid waste?

____incinerator ____landfill ____recycling ____dump

10. What is the "tipping fee" (cost per ton) to deposit municipal solid waste at Rhode Island's Central Landfill? (1986)

____$2 ____$9 ____$33 ____$100



"Oscar's Options"
83 Park St
Providence, RI 02903

Teacher's Page

WHAT DO *YOU* KNOW ABOUT TRASH?

1. The average family of four creates about 150 pounds of trash each week.

   *If a family of four creates 150 pounds of waste weekly, how much would that amount to in a year? (150 x 52 = 7800 pounds) Help your class to envision almost 4 tons of waste by comparing it to: 9 horses (950 lbs. each), 4 1/2 cows (1800 lbs. each), 5 pilot whales (1500 lbs. each), or a WW II German fighter plane (7700 lbs.).

2. In the past fifty years, the amount of waste discarded per person in the U.S. has *doubled*.

   *What reasons can you think of to explain this increase in waste?
   –increased packaging
   –increase in items designed for one use only
   –increased industry
   –higher personal income resulting in greater purchasing power
   Discuss with students the fact that Americans generate more solid waste per person than do people in any other country. We throw away 3 kg. per person daily. Yet Australians discard 0.8 kg./person each day, and people in India throw away only 0.2 kg./person per day! Students should contemplate the causes: different buying habits, different ways of life, the fact that Australia and India are much less developed than the United States.

3. Each day, Americans throw away 400 million pounds of edible food.

   *Mention waste in the school cafeteria and the food discarded at home. What else could be done with this food?
   –it could be composted or used as animal fodder
   –smaller portions could be served initially to cut down on waste
   –usable surplus could be donated to foodbanks or organizations which feed the needy.
   The United Nations estimates that 460 million people do not receive an adequate amount of the right kinds of food. The diet of these people is frequently lacking in:
   –calories (fewer than 2200 calories per person each day is the norm throughout China, India, and much of Africa. We consume more than 3300 calories per person each day in the U.S.)
   –protein (less than 60 grams per day in the above named places compared to more than 90 grams each day in the U.S.)
   –needed micronutrients.
   Malnutrition exists not because we don't produce enough food, but rather because of unequal distribution of what is grown. The most affluent third of the world's population eats well over half the food produced. (See OSCAR'S OPTIONS, Book I, Natural Resources, lesson 4.)

"Oscar's Options"
83 Park St
Providence, RI 02903

4. We send 20,000 cars to the junkyard each day.
*What could be done with the cars instead of just throwing them away?
  - We could reuse the metal, batteries, tires and other parts for auto repair and body work.
  - We can recycle the tires, batteries and plastic interior shell.

  Twenty thousand cars, placed end to end, would result in a line over 50 miles long, the full length of the state of Rhode Island. In the course of a year, Americans discard over seven million cars — enough to stretch 17,500 miles (two-thirds of the distance around the earth at the equator)!

5. How many years does the average American own a car? 5

   *Why do you think we trade cars in so frequently?
   (to keep up profits, manufacturers try to convince drivers to purchase new automobiles by changing the styles, updating options, and planning obsolescence. Only certain models are expected to "last" past the 100,000 mile mark.)

6. How many TVs are thrown out each year? 7.6 million

   *If a television set will last 10 to 15 years, why do you think so many are thrown away? (product variety, improvement over time – from tubes to printed circuits, from black and white to color, a variety of sizes from micro to widescreen, a variety of fashion colors) Again, the manufacturers convince us that a new (or another) TV is needed in our lives, even if the old one continues to function perfectly well.

7. What percentage of packaging (boxes, bags, and wrappers) is thrown out right after purchase? 90%

   *Can you think of ways to reduce this percentage to reduce our litter and solid waste problem and to save natural resources as well? (Use reusable packaging – paper bags, straw baskets; boycott certain items which carry excess packaging and alert manufacturers to your dissatisfaction.) Fast food packaging is one of the largest litter items, and most of it (styrofoam and plastic lids) is not biodegradable or recyclable.
   Therefore, although the packaging is in use for a very few minutes, it will persist in our landfills for literally thousands of years. Discuss with students how this practice might be changed. (see also OSCAR'S OPTIONS, Book I, Litter Unit)

8. How much paper do Americans use each year? 50 million tons

   *What are ten things we use paper for on a daily basis? Can you think of ways to reduce the amount of paper we use? (schoolwork, newspaper, cereal boxes, paper bags, stationery, magazines, tissues, napkins, paper towels etc.) Assist students in finding ways to change their behaviors and lessen consumption by substituting materials which can be used repeatedly whenever possible.) Explain to students that it takes 10,000 trees to print the Sunday *New York Times* each week – and that most papers are discarded the next day!

9. How does Rhode Island get rid of most of its solid waste? landfill

   *Ask students if they know the meaning of the other terms – they will be discussed at length throughout this volume.

10. What is the "tipping fee" (cost per ton) to deposit municipal solid waste at Rhode Island's Central Landfill as of 1986? $9

    *Do students feel that this is too much, too little, or just right? Explain that, in 1987, citizens in Fall River paid $60 per ton, Bostonians paid $65 – $90/ton, and New York City residents paid $90 – $150/ton to place trash in a landfill. Our rate is so low because it is subsidized by the state. The state owns the landfill and, therefore, taxpayers help to support it both directly and indirectly. Because of this system, we all pay the same amount for waste disposal, regardless of how much trash we personally create. Unfortunately, this amount may not be sufficient to protect us adequately from the possible loss of valuable drinking water supplies through contamination. Also, perhaps because trash is so inexpensive to dispose of, Rhode Islanders are too casual about the amount of waste we create.

OUT OF SIGHT, OUT OF MIND

GOAL: To help students visualize how much waste is generated for each person in Illinois and understand how the number of people living in our state and country affects this amount.

MATERIALS: 4.7 pound bag of miscellaneous trash (wash containers, avoid items with sharp edges)

PROCEDURE:

1. Describe trash and list some examples. Discuss:
   - What qualities does an item have that makes you decide it is trash?
   - What different kinds of trash are there?
2. Dump the 4.7 pound bag of trash on the floor. Discuss:
   - Does this seem like a lot of trash? *This much trash is thrown out each day for every person in Illinois.*
   - How do you think the number "4.7 pounds" was calculated? Who figured out this number? Will the number ever change? Why?
   - How do you feel about the fact that you are responsible for 4.7 pounds of trash that is thrown out each day?
3. Calculate:
   - Convert these numbers from pounds into tons. How many tons of trash do you make every week, month and year?
   - To help you visualize how much a ton weighs, add the weights of students in the class until you reach one ton. How many students does it take to make a ton? How many "students-worth" of trash do you make every week, month and year?
   - How many people are in your family? If 4.7 pounds of trash is generated each day for every person, how many pounds or tons of trash does your family make every week, month and year?
   - How many people live in Illinois? How many pounds or tons of trash are generated each day in Illinois?
4. Discuss:
   - What happens to all the trash you throw away?
   - What do you think happens to waste at the landfill?
   - What are possible problems with piling waste in landfills?
   - What would you do with your family's trash if there were no truck that came to take it away? How might this affect the amount of trash your family makes?

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Office of Waste Managment
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St. Paul, MN 55108

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REDUCING CLASS TRASH

GOAL: To have students realize that reuse and recycling of materials aren't the only or main solutions to the solid waste problem. A key step is to cut down on the use of materials that become solid waste.

PROCEDURE:

1) In what ways can you reduce the amount of trash you throw out at school? Don't forget to consider waste from the art room, shop, lunch room, etc. Write your ideas on the blackboard and request that it not be erased for one week.

2) For one week, cut down on your use of paper, food packaging and other materials. Refer to the suggestions on the blackboard. Note: It isn't fair to "cut down" by throwing things out in other trash cans in the school.

3) At the end of each day, calculate the amount of trash and list what individual items make up most of the trash. Calculate the volume of trash in each bag by measuring the width, length and depth of items in it.

4) Compare your findings with the amounts calculated in the "Class Trash" activity. (See Module II.)

Calculate:

- Did you throw out less trash when you tried to cut down? How much less?
- If your class cut down on use of materials for the school year, how much less trash (in pounds) would you send to the landfill?

Discuss:

- How easy is it to cut down on how much you use?
- Do you feel that it is worth doing? Why?
- Will you continue to cut down on your use of materials, or is this class activity a one-shot deal?

Pre- and Post-Activity Questions:

- *How can you reduce the amount of trash you generate in your class/ school each day?*

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1350 Energy Lane
St. Paul, MN 55108

GOING BEYOND:

■ Take home a copy of the checklist and questions and fill it out. Note to teacher: *Include a cover letter to parents explaining that the class is studying solid waste and recycling, and that you would like them to help their children see what kind of solid waste is generated at home.*

Discuss:

■ What did you find out about what your family throws away?

■ How do you feel about your findings?

■ What ideas do you have for what you could do with the trash generated at home?

■ Trace the "afterlife" of one of the items on the checklist. For example, what happens to the plastic bag or paper milk carton after it's taken to the landfill? Does it decompose? Does its decomposition create harmful byproducts? What impacts might its decomposition have on air, soil, water and health?

■ Create a reusable item from something you're going to throw away.

■ Investigate what used materials organizations like the Salvation Army and Goodwill Industries need and what they do with the materials they receive.

■ Discuss the role of yard sales, garage sales or tag sales in recycling and reusing materials.

■ Investigate how the amounts and types of wastes generated by a bank, grocery store, clothing store and hospital differ. How does each business dispose of its waste? Do any recycle materials?

■ Americans generate more trash per person than the people of any other country in the world. How do you feel about this?

■ Research and report on waste disposal habits of other countries. How do they deal with solid waste? Why don't they make as much trash as Americans?

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It's Your Trash

Goals:

To help students become aware that everybody contributes to the solid waste problem and that we should work together to solve the problem.

To introduce the practices of reducing, reusing, and recycling as a means to help reduce the amount of trash we generate.

Background:

Much of what ends up in our trash was once considered valuable, necessary, or desirable by us because of what was wrapped in it. Once discarded, it loses its value and becomes part of a messy, dirty problem called trash. There are many kinds of trash and many different ways to help alleviate our trash problem. Since we all generate trash, all of us need to do our part to help solve the problem.

Materials:

- small magnet
- four boxes or grocery bags labeled: *Reduce, Reuse, Recycle, & Trash*

Procedure:

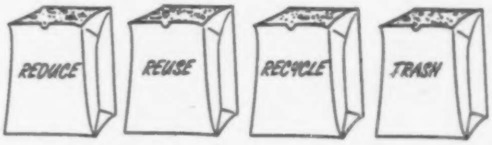
1. On the day before this lesson is taught, ask your students to help their parents make supper that night. Have them save all the containers that food came in. Bring those containers to school tomorrow. Send a note (like the one at the bottomof this page) home with each student to request parental assistance. Also, before you start this activity, find out what items can be recycled in your community.

2. At the start of class, have each child bring his/her empty food packages to the front of the room and put them in a pile on the floor. Ask students to explain what they had for supper and how the food was packaged.

3. Ask your class what they usually do with all of this packaging. They probably will say, "Throw it away."

4. Ask your students what they might call this pile of stuff. Write a definition of trash on the blackboard. Trash: things we throw away because we don't want them anymore.

5. Ask them what this pile of stuff would be called if it was scattered all over the playground. Write a definition of litter on the blackboard. Litter: trash that's been thrown on the floor or ground.



Parent Letter

Dear Parent,

Tomorrow we will be learning about recycling in class, and we need some examples of food packaging. Please ask your child to help you make supper tonight and save all of the packaging or containers that your food came in. Assist him/her with opening, emptying, rinsing, and drying them. Send them to school with him/her tomorrow. Thank you for your help.

Sincerely,

"K-3 Supplement to the Recycling Study Guide"
Wisconsin Department of Natural
Resources Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

6. Have two or three volunteers sort the trash into several piles of similar items. Ask these questions:

- What are these things made of? (glass, paper, plastic, metal, etc.)
- Are all of the cans the same? Using the magnet, give several students the opportunity to sort the magnetic metal (steel) from the aluminum.
- Were these items trash when you first bought them?
- Why did you buy them?
- What makes them trash now?
- What do you think about trash? Or, What words can you use to describe trash? Write these on the blackboard.

7. Then ask them:

- Whose trash is this?
- What should we do with it? Put it in your desk? Keep it in this room? Why not?
- Where should we put it?
- Whose job is it to take care of trash?
- Do we make too much trash?

8. For older students, write "Throw Away" on the black board. Ask: Where is "away"? What happens to trash?

9. Place four boxes or shopping bags labeled *Reduce, Reuse, Recycle* and *Throw Away* next to the trash.

- Discuss with your class what each of these terms means.
- Ask students to help you sort out items that can be recycled and reused.
- Discuss how each can be recycled and reused as you place it in the appropriate container.

10. Next, ask them how the amount of trash that's left can be reduced. (Buy food in bulk so there won't be as much packaging, buy food in containers that can be recycled or reused, etc.) Put items that could have been reduced in the *Reduce* container.

11. Put what is left in the *Trash* container. Ask the class:

- Is it better for the environment to reduce, reuse, and recycle? Why?
- What can you do to reduce, reuse, and recycle at home?

12. Finish the activity by appropriately taking care of the recyclables and the "trash".

Going Beyond:

- Copy and give your students the **Recycling Maze** worksheet found on page 9. Ask them to follow the path from their house to the recycling center, collecting all six recyclable items along the way.
- Encourage your students to recycle at home. Find out what is recyclable in your community and how to sort and prepare those items for recycling. Contact your local Departments of Public Works or Solid Waste Management, or call recyclers listed in the Yellow Pages for this information. Copy and give your students the **Recycle—It's Easy** take-home instructions for recycling found on pages 13-14. Ask them what is recyclable in their community. With your knowledge and their input, direct them to check the "yes" or "no" box for recyclability in their community under the directions for each item. Go over the simple directions for each recyclable item. Send **Recycle—It's Easy** home with them, and encourage them to help their families recycle.
- Copy and give your students the **Trash It Or Recycle It** worksheet found on page 10. Ask them to draw a line from each item to the proper container it should be placed in.
- Set up a "Reuse Box" in the classroom for paper that has been used on only one side. Encourage students to use it.
- Collect aluminum cans, plastic soda, milk and detergent bottles, and other items that can be recycled in your community. Take them to a recycling center and use the money to support your school recycling project or to take an environmental field trip.
- Ask the custodian not to empty the waste basket for several days (do not put food wastes in basket). What are your students' reactions? Discuss these with the class.

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Resources Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Is It A Waste?

Part 1 — All Wrapped Up *

Background: Why do we buy one product instead of another? Often it's because of the packaging. Packaging accounts for 10-15% (and sometimes more than 50%) of the cost of a product and 40-50% of all consumer wastes. While packaging often is designed to protect merchandise, it also is designed to sell products. Excess and non-recyclable packaging add to our energy and waste problems. We can cut down on packaging.

Stone's
Peanuts

Goal: To have students investigate the purpose of packaging and identify wasteful packaging.

Subjects: Home economics, marketing, social studies, language arts, health, science, environmental education.

Grades: 4-12

Procedure:

1. Bring in an example of food packaging. Discuss:
- Why is the product packaged? (To protect the product, protect health, prevent theft, provide advertising, provide convenience, promote purchasing, make the product look larger or more appealing?)
- Is the packaging essential or wasteful? Why or why not? What criteria are you using to make your decision?
- What influence do you think packaging has on the salability of the product?

2. Design a way to categorize the packaging. For example, sort it according to "natural" packaging (bananas, apples, peanuts); "older" packaging (paper bags, returnable bottles); and "modern" packaging (plastic wrap, styrofoam, plastic milk containers). Discuss:
- What happens to the packaging once the product is used?
- Which packaging is/isn't: recyclable, biodegradable?
- Which packaging is/isn't made from: recycled materials, renewable resources?
- What are the environmental pros and cons of making and disposing of each type of packaging?
- Which packaging would you label: most wasteful, least wasteful? Why?

3. Brainstorm ways that you could reduce the amount of packaging you purchase. For example, could you purchase products in bulk? How would this help reduce packaging? (A 3 ounce tube of toothpaste requires 50% more packaging per ounce than a 7 ounce tube.)

Pre- and Post-Activity Questions:
- List three examples each of recyclable and non-recyclable packaging.
- What criteria might you consider when deciding whether packaging is necessary or wasteful?
- What happens to most of the packaging you purchase? What do you think about this?

Part 2 — What's the Appeal? *

Goal: To have students quantify the number of times television and radio ads try to sell products for reasons not related to product quality and list some of the techniques advertisers use to promote products.

Subjects: Social studies, mathematics, language arts, home economics, marketing, environmental education.

Grades: 7-12

Procedure:

1. Find samples of different advertisements for the same type of item (soda, detergent, potato chips). Select ads for different name-brands and types of packaging. Discuss:
- Which product would you buy? Why?
- What is advertising? What is the purpose of advertising?
- Does advertising influence what you buy? How?
- Which advertisement do you like best? Why?
- Do your reasons have anything to do with the quality or function of the product?
- Do you purchase name-brand items instead of generic items? Why?

2. Discuss ways in which products are promoted on television, radio and in print. Analyze at least 25 ads. Note the following:
- What strategy does the advertiser use to sell the product?

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- What is the advertisement really selling: convenience, health, sex appeal, status, fun, quality?
- Does the advertisement mention the packaging?
- Is the packaging reusable or recyclable?
- Does the ad suggest what you should do with the packaging?

3. Design a chart to help analyze characteristics of these ads. A sample follows (feel free to add other categories):

4. Make a composite chart that shows the results of all the surveys done by students. Discuss:
- Which marketing strategies were used most often to promote packaged products?
- What strategies were used that were not listed on the sample form?
- What usually happens to the packaging?
- Do you think the manufacturer of the product should be responsible for what happens to the packaging once the product is used? Why or why not?

Pre- and Post-Activity Questions:
- Name three reasons you buy one type of packaged product instead of another.
- How often are your reasons based on the quality or function of the product?
- Discuss ways in which advertisements may influence what you choose to purchase.

Name of Product	Television	Radio	Print (magazines, newspapers)	Other	Status	New and Improved	Convenience	Sex Appeal	Symbols	Self-Image	Famous People	Flashy Packaging	Band Wagon	Vague Pronouns	Keeping Up With the Joneses	Other

Part 3 — How Many Ways Can You Wrap An Apple?

Goal: To have students design packaging and advertising strategies to sell a product, analyze why they decided on their strategies and consider why they buy one product instead of another.

Subjects: Social studies, language arts, art, drama, environmental education.

Grades: 6-12

Materials:
- an apple or other object (hammer, child's toy, batteries) for each student or group of students. Each student or group should have the same item.

Procedure:

1. You have just gotten a job as an advertizing agent for an apple company (you can work either individually or with a group of other students). Your first assignment is to develop a packaging design and ad campaign to sell apples. Keep track of the reasons why you chose your particular design and sales pitch. Your campaign can consist of skits, poems, songs, posters or whatever you believe will sell the product.

2. Present your ad campaign to the class.

3. Display the "products" (numbered in some way). Vote for the apple you would buy (each classmember should vote anonymously on slips of scrap paper). Tally the results. Discuss:
- Why did you choose the product you did?
- How much packaging was involved in the "winning apple?" Was the packaging necessary? Why or why not?
- What influence does the packaging have on the quality of the product?
- Why was the product packaged?
- Who pays for the packaging?
- Who should pay for disposal of the packaging?
- Was the manufacturer of the product concerned about disposal of the packaging?
- If the manufacturer is primarily interested in selling the product, is it more important to package the item to sell than to package it to have low environmental impact? Are these two concepts mutually exclusive? Could you design a package that sells but doesn't use a lot of energy or resources to produce or dispose of?
- Who should pay for the disposal costs of packaging that isn't recyclable or reusable?
- Do you have any choices about how much packaging you purchase?

Pre- and Post-Activity Questions:
- Who do you think makes decisions about what packaging to use on a product?
- What main factors do you think they consider when deciding how to make their product sell?
- Why do you think people buy products that have a lot of packaging?
- How often do you think manufacturers consider the impacts of packaging on the environment?
- Do you have to purchase highly packaged items?

"Recycling Study Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Big Bag—Small Bags

Goal:

To help students learn to reduce waste by buying products in large packages instead of single serving packages.

Materials:

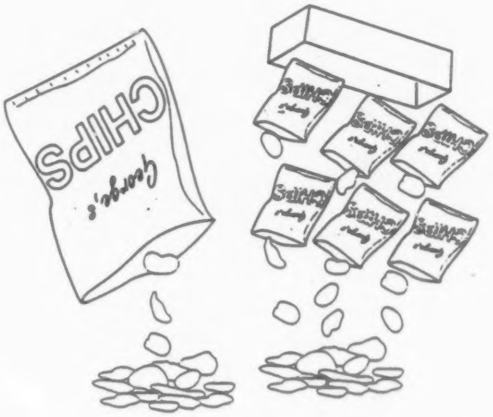
- large bag of potato chips
- same quantity of potato chips in single serving packages
- two trays

Procedure:

1. Buy a large bag of potato chips and the same quantity of chips in single serving packages. Note what each costs.
2. In class, place the large bag on one side of a table and the small bags (including all of their packaging) on the other. Ask your students: Which side of the table has the most potato chips?
3. Next, empty the contents of the large bag onto one tray and the contents of the small bags onto another. Place their respective packaging in two separate piles. Ask: Which tray has the most chips? Which pile has the most packaging?
4. Tell your students what you paid for each package of chips and what the chips cost per ounce for each tray of chips.
5. Lead a discussion on packaging based on your potato chip example. Talk about the merits of buying in bulk versus single serving packages. Ask your students how they can bring chips to school if their parents buy chips in big bags only.
6. Finally, divide up the chips and eat them!

Going Beyond:

- Bring in other examples of bulk versus single serving packages. Discuss the advantages and disadvantages of each.
- Encourage your students to investigate ways they can reduce waste, reuse things, and recycle at home. Copy and pass out the **Home Recycling Survey** found on pages 15-16. Ask your students to take these home and do the survey with their parents.



Jay's Potato Chips*

Package	Total Wt.	Wt. of Chips	Pkg. Wt.	Cost/oz.
1- 6.5 oz. bag	7.04 oz.	6.5 oz.	.54 oz.	$ .23
12-.05 oz. pkgs.	10.56 oz.	6.0 oz.	4.56 oz.	$ .35

*Priced on November 18,1990, at Woodman's Food Store in Madison, WI.

"K-3 Supplement to the Recycling Study Guide"
Wisconsin Department of Natural
Resources Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

CURBSIDE DETECTIVE

OBJECTIVE: Students will increase their awareness of the amount of solid waste produced.

SUBJECTS: Math, Science, Social Studies

SKILLS: observing, calculating, analyzing, critical thinking.

MATERIALS: survey sheet, pen/pencil.

PROCEDURE:

1. Survey your neighborhood and the amount of garbage placed on the curb over a 1 week period.
2. Fill in attached sheet.
3. Questions for discussion:
   a. Is your block a big garbage generator?
   b. Is your development/area a big garbage generator?
   c. Do you consider your family to be a big garbage generator?
   d. How can the amount "thrown away" be reduced?
4. Discuss the purpose of landfills.
5. Discuss the increasing problems with landfill space.

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CURBSIDE DETECTIVE

SURVEY SHEET

HOUSE NUMBER	GARBAGE BAGS LARGE	SMALL	GARBAGE CANS LARGE	SMALL	OTHER LARGE	SMALL

Total each column

Average per house

Number of houses on block ______ X ______ (avg. number of) containers Large = 2 small = ______ Total for block

Number of houses in development / area ______ X ______ (avg. number of) containers = ______ Total

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FAST FOODS—FRIENDS FOREVER

OBJECTIVE: Students will become aware of the excess packaging in fast food places.

SUBJECTS: Social Studies, Math

SKILLS: observing, surveying, researching, critical thinking.

MATERIALS: survey form, pen/pencil.

PROCEDURE:

1. Discuss with the students the types of packaging items used in fast food places.
   - —what are their purposes (keep food warm, easy to stack, identification, transportation, etc.)?
   - —are the same types of packaging used in all fast food places?
2. Have them visit a fast food place (or can recall from a previous visit if they cannot go) and observe (recall) the types of packaging used for different types of food, and record on the chart.
   - —record the types used inside
   - —record the types used in the drive-thru
3. After the charts have been completed, discuss with the students the following questions:
   - —How many times was that hamburger/chicken, etc. covered? (wrapping, then bag, etc.)
   - —Where do the customers place their "garbage"?
   - —Is any of that "garbage" recyclable?
   - —Do "fast food" places use anything difficult to recycle because it is convenient?
4. List or photograph places where you have observed fast food packaging as litter.

EXTENSION: Research packaging techniques in the "fast food" places in Japan.

*Recommended to use more than one fast food franchise.

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FAST FOODS-
FRIENDS FOREVER

SURVEY SHEET

Fast food restaurant ______________________________

Inside / Outside (circle one)

Customer	Number of items purchased	Types of packaging (styrofoam, plastic, paper)	Other (napkins, straws)	Carried away in (bags, trays)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

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IT'S MY BAG

OBJECTIVES: The students will become aware of the volume and variety of materials they discard.
The students will become aware of their personal responsibility for garbage production.

SUBJECTS: Math, Science, Language Arts, Social Studies

SKILLS: decision making, critical thinking, classifying, measuring, creative writing, charting, calculating.

MATERIALS: large bags (four for each student, labeled), paper, markers, ruler.

PROCEDURE:

1. Distribute 4 paper bags to each student.
   —have them mark the side of the bag into quarters
   —mark each bag as "paper", "aluminum", "glass", and "other".
   —the students take these bags home
2. The students place in the appropriate "bags" the waste they *personally* discard during a 1 week (or 2 week) period at home. (This includes any wrappings from junk food, personal products, clothing packages, etc.)
3. After 1(2) week(s) the students bring in their volume amounts to be tabulated with the rest of the class.
4. When the data is collected, discuss the following:
   —Convert total volume of materials into percentages of total amount of class volume. What is highest? What is lowest?
   —Discuss the possible solutions available to reduce the amount of waste collected.
   —Define source reduction and how packaging solutions and purchasing can reduce waste.

EXTENSION: Brainstorm substitutions for items discarded.

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"LITTER LOOKOUT"

OBJECTIVE: Students will evaluate litter problems at specific community sites.
Students will develop possible solutions to community problems.

SUBJECTS: Social Studies, Science

SKILLS: mapping skills, observing, reasoning, recording skills, interpreting, problem solving, data collecting.

MATERIALS: notebook, pencil/pen, gloves, garbage bags, map, worksheet.

PROCEDURE:

1. Hold a discussion on litter problems in your community.
2. Make a list of the 5 worst sites and locate on map, as decided by the students. Select a site for study.
3. Divide the class into teams for site study and assign study area.
4. Each team visits its sector of site selected to determine sector's condition, the extent of litter problem.
5. List the types of litter, amount and how it possibly got there.
6. Clean site for further study (if possible).
7. List possible long-term solutions to the site's problems.

EXTENSION:

1. Research other places that might be a "litter" problem and put on map.
2. Study how long it took to become a "litter problem" again (weekly, monthly).
3. Is there a "trend" or "hot spot" in your community? How can it be solved?
4. Invite a guest speaker to discuss the litter problem in your community.

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PACKAGING! WHY?

OBJECTIVES: Students will:
- *understand the purpose of packaging
- *identify wasteful packaging
- *identify alternatives in packaging
- *learn to recognize products packaged in recycled materials

SUBJECTS: Science, Social Studies, English, Home Economics

SKILLS: critical thinking, identifying

MATERIALS: packaging brought in by students

PROCEDURE:

1. Ask students to bring to class examples of packaging.
2. Discuss the packaging:
   - a. Which products need the protection of packaging?
   - b. Which products need packaging to protect public health, prevent theft, provide advertising, or convenience, etc.?
   - c. Which packaging is recyclable?
   - d. How can you tell which paper packaging has been made from recycled materials? (Look for the recycling emblem, and if the paperboard is gray, it was probably made from recycled paper.)
   - e. Is any of the packaging unnecessary or excessive?
   - f. Which products can be sold in bulk?
   - g. What are the advantages to larger quantity products? (a 3 oz. tube of toothpaste requires 50 percent more packaging per ounce than the 7 oz. size.)
   - h. Which natural resources were used to make the packaging?
   - i. Could the package have been made to be more conservative of resources or energy?
   - j. Could this product be purchased in less wasteful packaging?

3. Discuss steps that can change marketing practices.
   Possibilities:
   - a. Not buying overpackaged products.
   - b. Letters encouraging retailers to carry returnables and recyclables (e.g., glass milk containers).
   - c. Letter to legislators urging container standardization legislation which would make possible an expanded system of returnable, reusable containers.
   - d. Letters to manufacturers suggesting changes in amount or design of packaging.
   - e. Letters to packaging companies urging increased use of recycled/recyclable materials in packaging.

EXTENSION:

1. How does recycling help grocery stores cut disposal costs?
2. What might influence manufacturers, wholesalers and retailers of packaging to take into account the waste disposal and resource use issues and problems related to packaging?

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"PLASTIC CONNECTION"

OBJECTIVE: Students will collect data on the use of plastics in our society.

SUBJECTS: Language Arts, Communications and Journalism, Social Studies, Science

SKILLS: writing, analyzing, researching, evaluating, reading, listing.

MATERIALS: library facilities (pamphlets, magazines, newspapers), notebook, pen.

PROCEDURE:

1. Brainstorm: How many everyday items are plastic or have plastic parts? (e.g., toothbrush, cars, radios, appliances, picnic items, etc.)
2. Each student keeps a record of typical day's use of plastic, writing down any use of plastic items.
3. Next day, compare lists and discuss how important plastic has become to everyday life.
4. Identify and evaluate the advantages and disadvantages of plastics.
5. Students select certain items and discuss how their packaging changed over to plastic. (e.g., milk cartons, radios, etc.)
6. Write 2 editorials.
   —One expressing the advantages of using plastics.
   —One expressing disadvantages of plastics.

EXTENSION:

1. Research the use of plastics in our future. Is the trend towards more or less use?
2. What was used in place of a given plastic item, i.e., liter and 2 liter soda bottles.
3. Write for information on plastic manufacturing and recycling.

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"RAP AROUND THE BLOCK"

OBJECTIVE: Students will become aware of the volume of litter in their own neighborhood or on their school grounds.

SUBJECTS: Communications, Language Arts

SKILLS: poetry, creative writing, observing, listening.

MATERIALS: pencils, paper, a "boom box" with a tape that can play a steady beat, a garbage bag or box, tape recorder (portable).

PROCEDURE:

1. With the class, walk around a block or littered area with a steady "rap" beat playing in the background. As one student notices a piece of litter, he raises his hand and picks it up. To the beat, he creates a short "rap" song relating that litter to a potential problem, real or imagined.
   e.g.:

   Soda can
   In my hand
   won't go away
   here to stay.

   Here lies a piece of gum
   Throwing it here was pretty
   dumb!

   etc., etc.
2. This procedure continues until the walk is completed and everyone has a chance to participate
   —should be a different "rap" for each person even if litter type is the same.
3. Each piece of litter is collected and brought back to class for discussion and review of types found.
4. "Raps" can be recorded at the time of the trip or written down by a "secretary" or individual on index cards.

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RAP ON WRAP

OBJECTIVE: Students will be aware of the variety and amount of wrappings used by businesses and manufacturers.

SUBJECTS: Math, Social Studies

SKILLS: writing, recordkeeping, reading, critical thinking.

MATERIALS: garbage bags, wrappers.

PROCEDURE:

1. Have the students collect three different types of wrappers from items purchased by the family.
2. Classify the type of wrappings the students have brought in. (i.e., plastic, cardboard, etc.)
   a. Is any of the packaging made of recycled materials?
   b. Are there wrappings that could be eliminated?
   c. Where might all the wrappings eventually end up?
   d. Are there ways to reuse any of the wrappings?

EXTENSION:

1. Have the students collect in brown paper bags the wrappings discarded by the family for a week.
2. Have the class calculate the following:
   a. The amount of wrappings produced by the students families.
   b. The average amount per person in the class.
   c. The amount generated by the people in the school.
   d. The amount generated by the city/town (contact town hall for population figures)

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SOLID WASTE SURVEY

OBJECTIVE: Students will become aware of specific facts to help them understand what happens with solid waste in their community.

SUBJECTS: Language Arts, Social Studies, Math

SKILLS: research, writing, reading.

MATERIALS: paper, pen/pencil.

PROCEDURE:

Organize the class into research groups and have them select a topic from below to produce a fact sheet, newsletter or poster and present it to the rest of the class.

- What is the population of your community? How many families? Check the growth over the past ten years.
- How many pounds of garbage are disposed of in New Jersey? How many pounds are disposed of per person per day? Per year?
- How much does it cost to dispose of the waste per ton in New Jersey? In other states? In my county? In my town?
- How is garbage disposed of in your community? Is it burned or buried? Is any of it subject to resource recovery processes or organized recycling?
- Are there recycling centers in your town? Are they run by private citizens or the town? Is it voluntary or mandatory? Do you "get paid" for recycling? If so, how much for each type of recyclable?
- Is there a local or county solid waste manager for your area? What are his/her duties? Invite the person to speak to your class.
  - Where did the person go to school?
  - What type of degree is needed?
  - What type of courses have to be taken?

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GARBAGE THROUGH THE AGES (A SKIT)

OBJECTIVE: Students will become aware that historical methods of getting rid of solid waste won't solve modern garbage problems.

SUBJECTS: Social Studies, Language Arts, Drama

SKILLS: communicating, dramatizing, group work, listening.

MATERIALS: props, script.

PROCEDURE:

1. Select the students who will participate in the skit.
2. Procure the props needed for the skit.
3. Proceed with the skit.
4. Discuss the skit with the class for ideas, comments and questions they might have.
5. Perform the skit for other audiences.

EXTENSION: List three (or more) waste disposal problems today's society must solve which did not exist 100 years ago. The central idea is that as the skit progresses, each person throws more trash on the pile in the middle of the room so that a high stack is created. The skit suggests that one way to solve the problem is to recycle. A discussion of ways to solve the problem of too much garbage and trash might follow the performance.

GARBAGE THROUGH THE AGES
(skit)

Person 1

This is the tale of the Throwaway Three.
Of Man and his Garbage throughout his-to-ry
Now they're very nice people, just like you and me
Who all have a problem, as you will soon see—
What shall they do with their garbage and trash?

All

Why, throw it! Or bury it! Or burn it to ash!

Person 2—90,000 BC (Monkey)

I represent people when we lived in a tree.
I get rid of garbage so easily!
It's a snap! It's no problem—to me or to him.
We just let go, plop! Down through the limbs.

(Monkey masks, banana peels)

Person 3—50,000 BC (Cave dweller)

I am a cave dweller who lives on the ground.
What do I do with old stuff all around?
Why, burn it, like meat; burn it up in the fire;
Or bury it like bones, in the muck and the mire.

(Skins)

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All

Yes, throw it, or bury it, or burn it to ash!
That's how we always get rid of our trash!

Person 4—200 BC (Roman)

I am a Roman who lives in the town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile
And then I can dump it, forget it, and smile!

(Roman helmet, bag of trash)

Person 5—1200 AD (Briton)

I am a Briton, wary and quick;
Down on our street it can get pretty thick.
When housewives up there want to pitch out their goo,
They just leave it out there and yell: "Gardy-loo!" (Person 1 stands on chair and yells, "Gardy-loo!")
It will stay there and stay there until the next rain,
Or until our fair London should burn down again.

(Stack of trash)

All

Oh, what do we do with our garbage and trash:
We throw it, or bury it, or burn it to ash!

Person 6—1630 (Settler)

I am the settler. I came without much,
But everything else I must make with my hands.
So I don't throw out much—I use all I can.
Cloth scraps become quilts; I reuse my bent nails
It will be a long time 'fore the next trade ship sails.

(Pilgrim hat)

Person 7—1700 (Colonist)

I am a colonist; now life's not so tough.
We have trade between cities that brings lots of stuff.
And some things are made by our townfolk today,
I could buy a new harness, throw this old one away.
We have pigs and hogs running loose in our street,
If I toss it out there, they'll eat it up neat!

(Coonskin Hat, Leather)

Or I might bury it right over there.
Or I might burn it; nobody would care.
You see; the New World is the same as the Old!
We trashmakers come from the time-honored mold.

All

What are we still doing with garbage and trash?

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You guessed it! Throw it away, or bury it, or burn it to ash!

Person 8—1890 (Industrialist)

I'm the industrialist person and new on the scene,
I mass-produce goods with my trusty machine.
This sweater, handmade, took a week in days of yore,
But now in one hour, I can make forty-four.
I make things so cheaply, you can now afford two,
And throw out twice as much trash as you need to do.

(Engineer's Cap, 3 Sweaters—one handmade and two machine made.)

Person 9—1950 (Scientist)

I am the scientific person in the new post-war age.
We've learned a few tricks while the war shortage raged.
When we couldn't get natural stuff to process
We invented synthetics to replace the rest.

(Lab Coat)

Person 8 (Industrialist)

Rayons and nylons, acrylics and plastics,
For furniture and clothing and even elastics;
Forget your old woolens and silks and your cotton;
Real wooden toys and washboards are forgotten.

(Nylon stockings, Plastic Bags and Containers)

Person 9 (Scientist)

Our new stuff will last 'til forever, you see
Even when it's worn out to you and to me.
Permanent pressed, pre-sized and pre-shrunk
When dingy and old, it's still permanent "junk"
(Person 1 yells, "Junk")

(Perma-pressed shirt)

Person 8 (Industrialist)

We make instant menus that come in a pack.
You just boil the food in its own plastic sack.
Or our TV dinner in its tinfoil tray
It's quick; you don't wash it; just throw it away!

(Plastic bag, TV dinner)

Person 9 (Scientist)

We make lots of TVs and clothes dryers, too.
Don't ask for a trade-in; you're kidding, aren't you?

(Broken small appliance)

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Person 8 (Industrialist)

Our new cars all change with each model year,
Don't try to repair them, the cost's much too dear.
Besides, we don't bother to make last year's parts
For Skylarks, or Novas, or Cougars, or Darts.

(Toy car)

Person 9 (Scientist)

It's the New Thing, the NEW that America craves.
So out, out with the old stuff, away to its graves.

Person 8 (Industrialist)

So what if there are more of us buying more goods?
So what if they won't rot away as they should?

Person 10 (Lenne Lenape Indian)

Now wait just a minute! You cannot fail
To include me in your historic trash tale.
We Indians lived simply, on prairies, in woods,
We made no high trash piles, nor mass-produced goods.
Let me be your critic, show you where you stand;
And tell you just how you're defiling our land.
Your new-fangled goods will not rot away.
When you throw them all down they remain where they lay.
Then you say you will bury them deep in the ground:
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up our air with smoke, deadly gases!
Oh, all of your answers have faults everywhere:
You'll either ruin the water, the land, or the air.
What's more, your resources—your lumber, your ore—
Get smaller each year than the year before.
And what's more—this old earth's not making any more.

(Indian headband)

Person 8 (Industrialist)

You're right. Our resources are shrinking away
While our garbage problem grows bigger each day.
We're always converting resources to refuse
Instead of recycling them for reuse!

(Throw out old Blanket and Soda Bottle)

Person 9 (Scientist)

Oh stop it! Don't drop it! We'll think of a way
to make food for cows that's much better than hay.
Don't burn it, return it—we'll make something new,
A vase for your mother, a spyglass for you. (Flower in bottle for vase, flower out, bottle held up to eye for spyglass)

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Don't bury it, carry it—back to the mill.
We'll make a new blanket to ward off the chill. (Pick up old blanket and wrap around shoulders)

(Pick Up Orange Peels, Clear Bottle, Flowers)

Person 8 (Industrialist)

It's time we progress past the Disposal Age
And make recycling the popular rage!
We'll have to give up old solutions for trash
And all realize that its pure balderdash—to just

ALL

Throw it, or bury it or burn it to ash!

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THE CHOICE IS *CLEAR*

Math Activity (Graphing)

Students will create bar graphs to compare different beverage containers and determine which are the most ecologically sound.

MATERIALS NEEDED

Student worksheet (one per student)

IMPLEMENTATION

Review with students the reasons why recycling is a wise environmental practice.

Distribute student worksheet and assist students in reading the chart to compare different beverage containers according to the criteria listed.

Instruct students in the formation of a bar graph to compare the energy consumed in producing each type of container. Demonstrate how to label the vertical and horizontal sides, and explain the importance of a title on the graph so that others will know what is being displayed.

Have students complete five more bar graphs independently to demonstrate how each container compares according to the various criteria.

Discuss with students which containers appear to be the best and worst environmental choices. Explain that by recycling the steel, 60-70% of the energy is saved. Recycling the aluminum saves 90-95% of the energy. This is, of course, completely lost by using such containers only one time.

EXTENSION

Urge students to identify and carry out methods to influence either manufacturers or consumers in making better choices regarding beverage containers.

SOURCE

Statistics are from *Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives*, U.S. EPA; *Garbage Reincarnation*

"Oscar's Options"
83 Park St
Providence, RI 02903

THE CHOICE IS *CLEAR*

Your parents and grandparents may well remember when milk and soda came in glass bottles. The empty bottles were returned to the store. When the store collected enough bottles, they were trucked back to the bottling company. Sterilization guaranteed there would be no germs left on the bottles. Then each bottle was refilled and sent back to the store. Some bottles made this trip as many as 20 times. When the bottle broke or became too badly scratched, the glass was melted down and reformed.

In the 1970s, things began to change. Milk started appearing on grocery store shelves in wax cartons and plastic jugs. The soda industry switched to plastic containers. Businesses made this choice based on cost. They found it cheaper to make millions of plastic bottles than to reuse glass ones. Perhaps, for the manufacturer, it does cost less. But what about us? We pay for this through energy and water consumed. Air pollution and increased solid wastes are also part of our cost.

STUDY THE CHART BELOW.
USE THE INFORMATION TO CREATE SIX BAR GRAPHS.

CONTAINER COSTS FOR 1000 GALLONS OF SODA

Times used	GLASS 19x	GLASS 1x	ALUMINUM 1x	PLASTIC 1x	STEEL 1x
Energy (10^6 BTU)	15.90	64.38	75.61	63.33	38.83
Water (1000 gal)	11.35	38.94	15.17	41.71	39.01
Industrial Solid Waste (cu.ft.)	6.59	38.46	36.13	7.21	108.00
Atmospheric Emissions (lbs.)	70.52	261.01	323.02	240.07	145.08
Waterborne Wastes (lbs.)	27.43	56.46	69.00	68.79	18.14
Post Consumer Solid Waste (cu.ft.)	7.16	40.97	2.07	27.05	3.49

"Oscar's Options"
83 Park St
Providence, RI 02903

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SEARCH- A-WORD

Find and circle the 31 words in this activity. The words are found up, down and across.

Municipal Solid Waste
Solid Waste Management
Garbage
Anaerobic
Resource Recovery
Dump
Incinerate
Refuse Derived Fuel
Transfer Station
Sanitary Landfill
Litter
Source Separation
Trash
Biodegradable
Scrubber
Decompose
Solid Waste
Leachate
Composting
Aerobic
Landfill
Ecosystem
Waste Stream
Emissions
Energy Recovery Facility
Non Renewable Resource
Fly Ash
Natural Resource
Tipping Fee
Recycle
Bottom Ash

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M L I S F E G H J K L W L I R F E P M H D A E L D R G H
U N D O B C Z X A S G D N D E V M G H W Q P U N U E Z X
N K L L H Q W E R J A F K L S O L I D W A S T E M S I D
I N C I N E R A T E R I N C O M F D C V V A I N P R A T
C B V D P O U I Y T B C A V U P D W Q U T B C A U I Y T
I L K W A S D F G H A I N K R K P O F G H A I N D F G H
P M N A Z X C V B N G P A N C M V F R T N G D C V B N G
A Y T S R E X G J B E A E T E L E A C H A T E E A C H A
L W Q T A C H K L I U L R Q R A C H K L I U C H K L I U
S B N E J K B D R Y I S O N E J K B C O M P O S T I N G
O Z X M Y V J F A E R O B I C Y V J F Q M N M B I J F A
L V C A L K G B H C S L I C O L K G B H C S P I G B H C
I J F N H J I J I Y C I C F V H J I J I Y C O C F I J I
D E L A N D F I L L B D E L E N D F I E C O S Y S T E M
W G H G K L U W A S T E S T R E A M H P M X E S T R M W
A F H E M N B V C Z F G O P Y V B F O C Z F A F N F M N
S H D M Y Y I O X G M I C J K U T R A X G M I V E F F O
T Y R E F U S E D E R I V E D F U E L D E R T Y H E F N
E D G N C X Z E T J X U W X Z Z N B E T J X E T A M I R
N C J T R A N S F E R S T A T I O N S F E R N C L T R E
D F E R Y B N A H F U D F E R Y B N A H F U E F E R Y N
E M I S S I O N S J K E T Y R E Y M C X J K R M I D S E
K H G H D V Z I Y I K K H G H D V Z I Y R Q G Z G H D W
S O I L N L I T T E R S O I L N N M W A F L Y A S H N A
O H C V B N S A F H K O H C V B N S A F H K R H S V B B
U R E N A T U R A L R E S O U R C E R A L R E S O N R L
R F N V X S E Y T T Y R F N V X S E Y T T Y C T N V X E
C H J I Y B C L D S D C H J I Y B C L D S D O H Y I Y R
E M N V X T R A S H J E M N V X F M D K Y J V B N V X E
S G H V D F G N O R E S G T I P P I N G F E E G T K P S
E H N K D F R D A S Z E H N K D F R D A S Z R H L K D O
P C X Z V G R F I L B P C X Z V G R F I L B Y C X Z V U
A G H J K L B I O D E G R A D A B L E O D E F R A D A R
R H J Y I O U L G D X R E J Y I B O T T O M A S H Y I C
A J W E W E R L X P P A C W E W E R L X P P C R L X P E
T K L H F G H B Y T T T Y L H F G H B Y T T I Y H B Y T
I O N G D G F S E W R I C N G D G F S E W R L C N F S E
O N H F C V B N X S Q O L H F C V B N X S Q I L H F B N
N J I O J F S C R U B B E R O Y Y S C R U B T R C P U B
V B X D F G H J K L N B B J W G I O N K L N Y H N A L N
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TREE AMIGOS

"Here Today, Here Tomorrow-Revisited"
NJDEP, Division of Solid Waste
Management Education Program
CN 414, 401 E State St
Trenton, NJ 08625

"WHY BUY ME?"

OBJECTIVES: Students will identify some of the influences, appeals, and techniques advertisers use to promote products.

Students will determine if recyclability and waste reduction are used as selling points in advertising.

SUBJECTS: Social Studies, English, Home Economics

SKILLS: critical thinking, brainstorming, classifying, listing.

MATERIALS: pens, survey chart, magazines, survey sheet.

PROCEDURE:

1. Brainstorm various techniques used to promote products on television, radio, and in print. Bring examples from magazines to class. Examples:
   - —The use of vague pronouns;
   - —Sex appeal;
   - —Flashy packaging;
   - —Convenience;
   - —"New and improved";
   - —Status symbols / conspicuous consumption;
   - —"Band wagon," everybody has one;
   - —"Keeping up with the Joneses";
   - —Famous or glamorous people promoting product;
   - —Improving self-image (by using products associated with glamorous people);
   - —Symbols or repeated images;
   - —etc.
2. Distribute the survey sheet and review.
3. Have students complete a second chart quantifying the advertising techniques used in one hour of television programming and fill in the chart.
4. Have students compare their charts for their similarities and differences.
5. Discuss:
   - a. Which techniques are used most often?
   - b. Which techniques not on our list did you identify?
   - c. How often were recyclability, product durability, good effect on the environment, or waste reduction promoted as positive product attributes?

EXTENSION:

1. Discuss: Does advertising work, i.e., is advertising effective in getting people to buy certain products?

   Judging from your survey, are advertisers concerned about the effects their products will have on the environment?

   Are advertisers concerned about waste reduction?

   How do you think consumers would react to advertising that included product durability, recycling, and waste reduction as selling points?

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WHY BUY ME?

SURVEY SHEET

Name of product	Television	Radio	Magazines	Newspapers	Status	New & improved	Convenience	Sex appeal	Symbols	Famous people	Flashy packaging	Self - image	Recyclability/waste reduction mentioned	Recyclability/waste reduction implied (longevity,etc.)

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WEEK'S WORTH

OBJECTIVE: Students will be aware of the amount of paper they throw away.

SUBJECTS: Math, Social Studies, Science, Art

SKILLS: calculating, graphing, predicting, observing, comparing, collecting data.

MATERIALS: student survey chart, paper for graph, magic markers / pen / pencil, ruler / yardsticks

PROCEDURE:

1. Discuss with the students the types of things that would be discarded while in school.
2. Have the students predict the number of that particular item to be discarded for a period of a week. The teacher will collect the predictions for use at the end of the survey.
3. Pass out and review survey form.
4. Have the students record all items thrown away in school for a period of a week.
5. Discuss with the class:
   - —What types of things were thrown away.
   - —Approximately what percentage of that was reusable paper.
6. Compile the individual results into a classroom set of data. Determine the percentage of each item
7. Discuss if recycling these materials would be an acceptable alternative to "throwing" them away.

EXTENSION:

1. With the cooperation of the custodian, remove the waste basket entirely for a week. Stipulate that no waste be disposed of outside of the classroom. Point out that many counties and cities across the United States are faced with this situation of producing waste but having few choices about where to put it.
2. At the end of the week, weigh the amount of accumulated refuse to come up with a per day and per person average.
3. Discuss ways to reduce the volume of waste the class produces.
4. Write to a U.S. paper recycling company for information.
5. Write a story of life without paper.
6. Write a story of life without wastecans.

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WEEK'S WORTH

List the items you throw away in school for the period of one week in the classroom and cafeteria.

Student Personal Survey Form

Monday	Tuesday	Wednesday	Thursday	Friday

Name

Class

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WASTE IN TIME

OBJECTIVE: Students will compare our present culture and lifestyle with those of the Native American Indians in relationship to products used and then discarded.

SUBJECTS: Social Studies, Home Economics, Technology

SKILLS: interpreting, critical thinking, comparing, researching.

MATERIALS: pen, worksheet.

PROCEDURE:

1. Distribute worksheets to individual or groups of students.
2. Have the students fill in the spaces comparing our present lifestyles with that of the Native Americans.
3. When completed, discuss the following:
    a. compare and contrast the two cultures and list on chalkboard.
    b. How do they differ?
    c. Why do they differ?
    d. Are there ways of reducing present day waste?
    e. What can you do to reduce waste?

EXTENSION:

1. Research what archaeologists have discovered from Native American trash piles.
2. Write a story about what an archaeologist in the year 3000 will learn about our culture from our trash piles.

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WASTE IN TIME

WORKSHEET

	PRESENT	NATIVE AMERICAN
LIST THE VARIETY OF FOODS CONSUMED		
SELECT A PLANT AND PIECE OF MEAT FROM EACH CULTURE AND TRACE ITS PATH FROM SOIL TO CONSUMPTION (INCLUDING PACKAGING,TRANSPORTATION, ETC.)		
LIST THE TRASH PRODUCED THROUGH THE CONSUMPTION OF THESE FOODS		
LIST THE TOOLS AND/OR THE APPLIANCES THAT WERE/ARE USED		
LIST WHEN AND HOW THESE TOOLS AND/OR APPLIANCES WERE/ARE USED		
LIST THE MATERIALS USED FOR CLOTHING		
LIST WHY,WHEN,AND HOW THESE CLOTHING ITEMS WERE/ARE DISCARDED		

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TO MARKET, TO MARKET

Language Arts, Social Studies

Students will determine whether environmental value decisions affect consumer choices.

MATERIALS NEEDED

"To Market, To Market" survey (two or more copies per student)

IMPLEMENTATION

Explain to students that choices we make in our daily lives affect the amount of waste we produce. Have students fill in the questionnaire and score themselves. Discuss the results. Are they concerned consumers?

Now, ask them to take the survey home and administer it to one or more adults (parents, grandparents, neighbors). Ask them to return to class with the completed forms. When all of the surveys are in, tabulate the results.

Discuss with students the importance of environmental issues for consumers. How does this affect the amount of solid waste we create?

EXTENSION

Share the results of the survey with your local newspaper and/or city and state legislators. Create posters, video commercials, advertisements on ways to reduce waste.

"Oscar's Options"
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Providence, RI 02903

TO MARKET, TO MARKET
Consumer Survey

Every day we make choices which affect the amount of waste we produce. Take a few minutes to consider your contribution to Rhode Island's solid waste stream. Add up the circled numbers in each column to find your total score. Use the information on the next page to see if you are a concerned consumer.

Do You	NEVER	SOME-TIMES	OFTEN
1. consider whether you really need something before you purchase it?	3	2	1
2. think about what will happen to a product or package when you no longer have any use for it?	3	2	1
3. try to reuse things you already have instead of disposing of them and buying new things?	3	2	1
4. consider what pollution and wastes were created in the manufacture of the things you buy?	3	2	1
5. take advantage of the opportunities to recycle in your area?	3	2	1
6. shop at second-hand stores or garage sales?	3	2	1
7. use dishcloths or sponges instead of disposable paper products which can't even be recycled?	3	2	1
8. avoid items such as disposable diapers, razors or lighters when longer lasting alternatives are available?	3	2	1
9. avoid eating in carry out places which wrap your food in lots of paper and plastic or ask that less wrapping be used for your order?	3	2	1
10. compost kitchen waste and other decomposable organic matter?	3	2	1
11. spend the money to repair an item even though you could get a new one for nearly the same price?	3	2	1
12. talk to store managers about stocking bulk products or avoiding packaging?	3	2	1
13. complain to manufacturers about "built-in obsolescence"?	3	2	1
14. write to government officials and leaders expressing your concerns about the need to produce less wasteful products?	3	2	1
15. read consumer information articles to find out about the quality and durability of products you buy?	3	2	1
	___	___	___

☐ + ☐ + ☐ =

Oregon Department of Environmental Quality
Solid Waste Division

grand total ______________________

"Oscar's Options"
83 Park St
Providence, RI 02903

TO MARKET, TO MARKET
Consumer Survey

IF YOUR SCORE WAS:

40 OR MORE

Like most Rhode Island residents, you are probably contributing your full share of garbage to our rapidly diminishing landfill space, including tons of useable, recoverable materials.

WHAT CAN YOU DO? Be aware of the amount of garbage you have each day. Note how heavy it is. What could be reused, recycled or avoided entirely? Next time you go to the store, check to see if any of the products you normally buy in non-recyclable containers are also available in returnable, refillable or recyclable containers.

BETWEEN 21 AND 39

You are doing some reducing, reusing and/or recycling. These patterns need to be practiced consistently by the majority of the population if we are going to reduce the increasing amounts of waste.

WHAT CAN YOU DO? Do some comparison shopping. Consider various types of packaging and the alternatives which are available. Does it cost more or less to buy reusable or recyclable packages? Take your own paper bags back to the market and reuse them.

20 OR LESS

You've obviously done some serious thinking about the need for resource conservation. It shows!

Think about the things you do to conserve. Which are you the most proud of? Encourage one other person to consider doing the same. Get involved in solid waste planning in your community. KEEP UP THE GOOD WORK!

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WASTE NOT, WANT NOT

Reading, Creative Thinking

Students will be introduced to the concept of source reduction and will understand that consumer choices may have direct environmental consequences

MATERIALS NEEDED

"Waste Not, Want Not" (one per student),"Be a Concerned Consumer" (one per student)

IMPLEMENTATION

Distribute "Waste Not, Want Not" and allow time for students to read the information. Discussion could focus on how planned obsolescence and advertising affect our behavior as consumers. Disposable products that encourage waste is another potential topic. Ask students to suggest ways that they could change their habits to reduce waste. Distribute "Be a Concerned Consumer". Read and discuss the suggestions. Ask students to share this list with their families and to return to class with information about family reaction to the suggestions. Share this information as a class.

VOCABULARY

compost
convenience
durable
fertilize
manufacture
planned obsolescence
source reduction

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WASTE NOT, WANT NOT

Did you know that what you buy can have an effect on your environment? Some products are made in a safe way; others are not. Some will last a long time; others are quickly consumed. Some products can be easily repaired or recycled; others are difficult to dispose of. You can choose products that are not harmful to the environment. Choosing a certain product because it creates less waste is called source reduction.

One huge source of waste is packaging. The average American now throws away over 600 pounds of packaging each year. When most people lived on farms, food moved directly from the field to the table. Leftovers were fed to the animals or made into compost to fertilize the fields. Today, most of our food comes from the supermarket. It is wrapped and packaged for safety and convenience. Now, the leftovers include the plastic, glass, metal and paper that the food came in.

Sometimes we buy things we don't need just to be in style. Companies advertise the latest cars, toys and clothes. They try to make us unhappy with what we have, so we will buy something new. Soon, that new product is replaced by something else. The old ones, even if still useful, often end up in the trash. Manufacturers could make basic products that are simple and durable.

We have choices. We can buy only products that are manufactured safely. We can buy things that last. We can try to be less wasteful. The choices we make today create the waste we must dispose of tomorrow.

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GARBAGE TO ASHES

Science and Math

Students will observe how incineration reduces waste and produces emissions.

MATERIALS NEEDED

A one-gallon can with several ventilation holes about 1 inch from the bottom; a piece of metal screen large enough to cover the top of the can; 5 pieces of cardboard, six inches square; masking tape; enough waste to fill a box 6 inches x 6 inches x 6 inches (paper, cardboard, magazine pages, lunch scraps such as orange or banana peels, egg shells, small milk carton, napkins etc.); matches; ruler; student worksheet (one per student)

***WARNING:* THIS ACTIVITY SHOULD BE CONDUCTED OUTSIDE OR IN WELL-VENTILATED AREA (PREFERABLY WITH AN EXHAUST FAN) UNDER CLOSE ADULT SUPERVISION!**

IMPLEMENTATION

Distribute student worksheets and explain that in this lesson they will be burning representative waste items to observe the effects of incineration. Tape cardboard pieces together to form a box with four sides and a bottom. Fill the box with the waste you have collected. Have students calculate the volume of the waste.

volume of waste = length x width x height
volume of waste = 6 in. x 6 in. x 6 in.
volume of waste = 216 sq. inches

Transfer the waste into the 1 gallon can. Light the materials on fire and immediately cover the top of the can with the screen. Observe what comes out of the can while the materials are burning. Have students record their observations in the appropriate area on the worksheet for future discussion. When burning is complete and ashes have cooled, return the ashes to the cardboard box. Spread the ashes evenly on the bottom of the box and measure the depth (height) of the ash layer. Using the same formula as above, calculate the volume of the ash. Now, calculate the difference in the volume occupied by the waste before and after burning.

VOCABULARY

volume
ash
pollution
incinerator
landfill

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Discussion: The above experiment has demonstrated that burning waste reduces the volume of that waste.

Is incineration an effective solid waste disposal method? What effect might incineration have on our landfill? (reduced amount of waste being buried, extended landfill life) While the materials were burning, what came out of the can? (black smoke, smoke, air pollution) What problems could this cause? (increased pollutants in the air, harmful chemicals in the air, sickness for people living near the incinerator, odors)

EXTENSION

Repeat the experiment with glass and metals(e.g., cut up pieces of an aluminum can, a few pieces of glass). The volume of waste remaining after burning is considerably larger than the previous experiment. Will removing recyclables such as glass and metals from the waste increase or decrease the effectiveness of the incinerator?

WARNING: DO *NOT* BURN PLASTICS!!!

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WORKSHEET – Garbage to Ashes

Calculate the volume of the waste
Volume = length x width x height

length____________________
width____________________
height____________________

Multiply:________________ x ________________ x ________________

Volume of the waste = ____________________

What comes out of the can while the waste is burning?
Record your observations here:

Calculate the volume of the ash:

length____________________
width____________________
height____________________

Multiply:________________ x ________________ x ________________

Volume of the ash = ____________________

Now let's see how much we have reduced the volume of the waste through incineration:

Volume of waste____________________minus the

Volume of ash____________________equals____________________

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TAKE-HOME "HOW TO RECYCLE" KIT

OBJECTIVES: The student will be able to:
— help solve solid waste problems by constructing a take—home "How to Recycle" kit
— explain source separation to their families

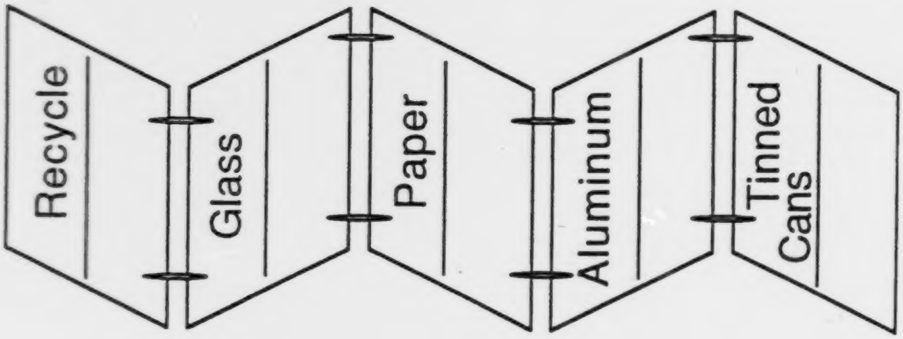
SUBJECTS: Social Studies, Art, Language Arts, Science

SKILLS: communicating, following directions, reading, writing.

MATERIALS: marking pens, glue, scissors, hole punch, colored construction paper, copies of information sheets, 5 eight and a half by eleven pieces of cardboard, magazines, used foil, used twine or ribbon, copy me pages.

PROCEDURE:

1. Assemble the Take-Home "How To Recycle" Kit":
   a. Have students cut cardboard into 5 eight and a half by eleven pieces.
   b. Glue different colored sheets of construction paper to one side of each cardboard piece.
   c. Have students label the top of each piece of construction paper using the following headings: Glass, Paper, Aluminum, Tin, Recycle.
2. Using the "How to Recycle" information, have them transfer the information in a creative manner on each section.
3. Using the magazines, cut out pictures of the different categories of waste. Paste these pictures below the label and above the directions on the corresponding cardboard sheets to form collages. In making aluminum cards,use aluminum foil brought from home.
4. Copy the "How to Set Up Your Home Recycling Center" sheet for each student.



5. Read and discuss with students how they might set up centers in their homes. Paste this copy on the "Recycle" sheet.
6. Have students punch two holes on the right hand side of the "recycle" sheet, two holes on both sides of the "paper", "glass", and "aluminum" sheets, and two holes on the left side of "tinned cans" sheet. Connect the sheets with ribbon or twine.

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7. Presenting the Kit:
    a. In preparation for teaching their families, have students in class practice in groups. Each group discusses various approaches and selects one group member to present his or her kit to the class. Following presentations, discuss which approach might be most successful. Students practice their presentations in pairs until they understand and can effectively communicate the information to each other.
    b. Have students present their kits to their families and report back in class on the reactions to their presentations.

EXTENSION: Discuss what groups in the community would welcome such presentations.

"Here Today, Here Tomorrow-Revisited"

Earth Day 1990

SOLID WASTE/RECYCLING LESSON PLAN—GRADES K-6

SUMMARY OF ACTIVITY:

Students survey themselves and their families to assess awareness levels and household practices related to recycling.

Time: Two 45 minute periods, with time in between to complete survey and fill in graphs.

Setting: Classroom, home

Materials:

- Examples of household garbage items.
- Butcher paper.
- Felt markers or crayons.
- Glue sticks.
- Home Recycling Survey.

BACKGROUND INFORMATION:

When we throw away garbage, it usually ends up in a landfill. Landfill space is getting increasingly scarce, and every time we throw something away we throw with it the energy, the money, the raw materials, and the water it took to make it.

The average American throws away 3.5 pounds of garbage per day. In 1990, it is estimated that Americans will throw away over 1 million tons of aluminum cans and foil, more than 11 million tons of glass bottles and jars, over 4 and a half million tons of office paper and nearly 10 million tons of newspaper. Almost all of this material could be recycled.

Recycling saves large amounts of energy. Recycling one glass jar saves enough energy to light a 100-watt light bulb for four hours. Recycling one soda can saves as much energy as if the can were half full of gasoline. Recycling an aluminum can results in *95% less air pollution and 97% less water pollution* than creating an aluminum can from raw materials. Manufacturing new paper products from waste paper uses at least a third less energy and cuts air pollution by 74 percent compared to making paper from wood pulp.

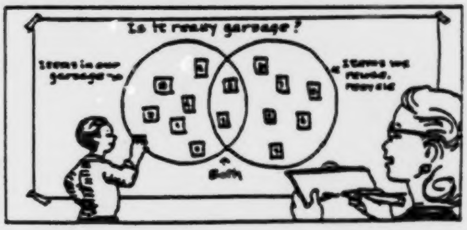
When waste products are recycled, fewer raw materials must be mined or logged. Americans threw away 35 billion aluminum cans last year—we threw away enough aluminum to build our entire air fleet four times over. Recycling paper reduces the pressure on our forests for wood pulp, so that less logging is necessary.

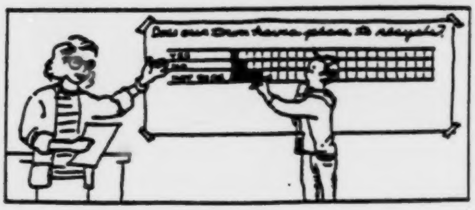
Of course, buying products that have less packaging reduces the amount of garbage going into the landfill in the first place. It is important to buy things that can be re-used or recycled. This is the concept of *precycling*.

PREPARATION AND LEAD-UP:

Collect a variety of household items that are thrown into the garbage, such as those things listed in question one of the Home Recycling Survey. Try to include items which could be used again, such as paper grocery bags and aluminum foil and things which create "instant" garbage such as disposable diapers and overpackaged products.

Prepare graphs like those below:





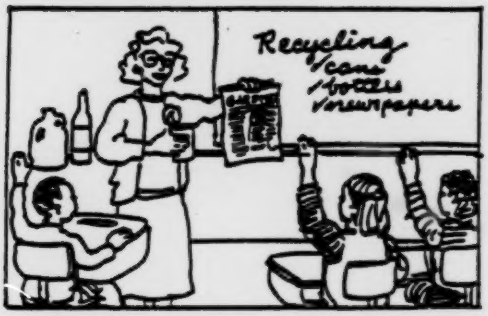
Prepare copies of the Home Recycling Survey, enough for one per household.

Earth Day 1990
P.O. Box AA
Stanford, CA 94309

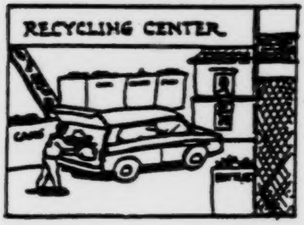
ACTIVITY FOR GRADES K-3:

Day One

Introduce the notion of recycling by displaying a variety of household items which are frequently thrown into the garbage (see Preparation and Lead-Up). Ask students to describe uses for each of these household products. Tell students that each of the items can often be found in the garbage. Quickly survey the class by holding up each item and asking for a show of hands if the item could probably be found in their garbage at home.



Tell the class that, in order to reduce the amount of garbage we produce, some of the items could be used again and some could be used for other purposes, and some could be "replaced" at the store by purchasing other products in the first place.



Explain to the students that when we use an item more than one time (for the same or a different use) we call it *re-using*. *Recycling* is having an item *re-made*. Recycling is good because the materials that come from the earth, such as trees that made paper, can be used again and again instead of cutting down more trees. And the original items will not pile up in the dump if they can be re-made (recycled). Ask students to brainstorm how a few of the items on display might be re-used and which ones can be recycled.

Tell students that they are going to take home a set of questions to be answered by them and at least one family member. Send home questions one through four or your own modification, based on student's abilities and community awareness of recycling.

Day Two

Set aside time for students to enter data on the graphs that you have prepared. Students should cut out the pictures from their surveys and put the ones with an "X" in the garbage circle and the ones without an "X" in the recycle circle. They can place items that can be recyled but get thrown away where the circles overlap.

Discussion Questions:

What items can be found in the garbage in *most* of our households?

Are any of the items used again (recycled) in *most* of our households? If so, what are they used for?

Does our town have a place where people can take items to be recycled?

If so, have any of you ever been there? What kinds of things did you take to be recycled?

Where do most of the people we surveyed think our garbage goes once it leaves our homes?

Why is it important to reduce the amount of garbage in our homes?

What are some ways that you might reduce the amount of garbage in your home?

ACTIVITY FOR GRADES 4-6:

Day One

Display the household items (see Preparation and Lead-Up) and ask students what characteristics the items have in common...and where the items might be found in their homes. Tell students that over the next two days they will be thinking about garbage and ways that people can reduce the amount of garbage they produce.

Ask students if any of the items could be used again, either in the same way they were used originally or in a different way. Introduce the term *recycling*.

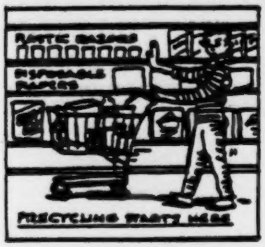
Hand out the survey and explain that the survey is not a test, and there are no right or wrong answers.

Divide the students into groups of four. Have each group discuss what their answers would be to the survey questions Then have them discuss the following questions:

- ◆ What three items on the list do you think are found in the garbage of most of your homes?
- ◆ Where do you think our garbage goes once it leaves our homes?

Have the group share their discussion with the class. Discuss with the students about why it is difficult for some people to recycle; their town may not have recycling facilities, their lifestyle is reliant upon disposable products, etc. Point out that everyone must define a starting point that makes sense for their lifestyles and begin there. They can gradually work on more ways to reduce the amount of garbage they produce.

Introduce the term *precycling* which means to reduce waste by not buying a product in the first place, buying an alternative product that produces less garbage or buying a product that can be recycled once it is used. Precycling involves selecting products carefully after considering the manner in which it is packaged, whether or not it can be reused or recycled, and its overall impact on the environment once it is discarded.



Day Two

Compile the data gathered from the survey and transfer it onto a chart for class discussion (see discussion questions).

Discussion Questions:

What did we find out from the results of this survey?

Does it appear that most of the people in our survey recycle some household items?

What ideas did the people surveyed have for *precycling*. (What alternative products did people list in question six?)

Why is it important to think about ways to reduce the amount of garbage we produce?

What might happen if we continue to use disposable products such as disposable diapers, razors, cups, etc.

What would it take to convince more people to recycle in our town?

Agree upon one way that everyone in your group could reduce the amount of garbage in his/her home. Make sure your choice is realistic for each group member (i.e., it is a product that every person now uses, it is re-useable, recyclable and/or replaceable with another product).

Resources:

Lesson Plan and Home Survey written by Carolie Sly, Alameda County Department of Education.

The Recycling Follow-Up Activity is adapted from the "Caring for the Environment" unit in the *The California State Environmental Education Guide*, (Sly, C.; Comnes, L.; Cuomo, C., 1988). This curriculum guide for grades K-6 is available from the Alameda County Office of Education, 313 W. Winton Avenue, Hayward, CA 94544-1198.

CONTINUATION PAGE—GRADES 4-6

5. a) Which items listed in question one could be saved and made into a new product?

5. b) If you are not sure, how might you find out?

6. What are the benefits and drawbacks of recycling to your family?

Benefits	Drawbacks

7. List five products that your family purchases which produce "instant garbage." They may come packaged in such a way that you throw away packaging as soon as you open them or they may be disposable so that you throw them away after using them only one time. Can you think of any alternatives to these products?

Instant Garbage	Possible Alternative

8. How does it help the environment to reuse things?

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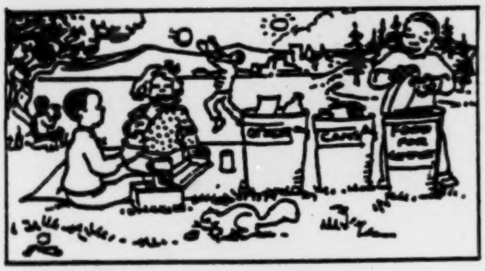
ECOLOGICAL PICNIC

RECYCLING FOLLOW-UP ACTIVITY—GRADES K-6



SUMMARY OF ACTIVITY:

Students plan and enjoy a picnic using a minimum of disposable items, then sort and recycle as much of the picnic garbage as possible.

Time: Varies, generally 30 minutes for planning, 60 minutes for the picnic, and 30 to 45 minutes after the picnic.

Setting: Classroom, outdoors

Materials:

- Typical lunch (see step 1).
- Two buckets or large cans for picnic garbage.
- One bucket with a tight-fitting cover for composting.
- Sawdust or dirt (optional; see step 8).

BACKGROUND INFORMATION:

People use disposable products for picnics and other occasions because there are no dirty dishes left over and no utensils that need to be taken home and washed. Just toss the products away and they seem to disappear. But there really is no "away"; all garbage must go somewhere. Any garbage that is not recycled contributes to the local landfill or becomes unsightly litter.

This activity reinforces the idea that students can make personal choices about their actions. In this case they will be making choices that will minimize the amount of waste generated by a class picnic. After the picnic students will collect the garbage that remains and recycle or compost what they can.

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PREPARATION AND LEAD-UP:

Choose a site for the picnic (if you want students to help choose the site, see the extension ideas). Possible locations are the schoolyard, a vacant lot, a park, a playground, a ball field, a lawn, or the side steps to the school building.

If the weather is not suitable for an outdoor picnic, move it indoors. Push all of the desks aside and have the picnic in the middle of the classroom floor.

Label the buckets to be used for garbage during the picnic. The one with the cover should be labeled "Food." The other two buckets should be labeled "Cans" and "Other."

ACTIVITY:

Day One

1. Decide upon a typical lunch that students might bring to school. Ask students to decide what items from the lunch would be thrown away. Ask if any of the pieces of garbage could be reused or recycled. Have students think of something that is reusable that could replace each disposable item (for ex-

Sample Letter

Dear Parents:

As the recycling activity for our lesson plan on Earth Day 1990, we are planning an ecological picnic on (date) at (time) to be held at (site). We have discussed ways to pack a lunch so that there will be as little garbage left over as possible (for example, using cloth napkins instead of paper napkins, bringing reusable silverware or reusable plastic silverware, putting food in reusable plastic containers when possible, bringing juice or milk in a thermos). Please help your child pack an ecological lunch for the picnic.

We will recycle as much leftover garbage as we can. Cans and aluminum foil will be recycled. Leftover food that can't be saved will be composted.

We will make a friendship salad the morning of the picnic. Students will contribute the fruit. We will wash the fruit and chop it at school, then enjoy it for dessert at the picnic. If you can contribute to the friendship salad, please send one or two pieces of fruit with your child on (date) along with his or her ecological lunch.

Also, we need two or three parent volunteers to help make the friendship salad and supervise the picnic. If you can join the fun and help out, please let me know.

Thank you.

ample, silverware could be used instead of plastic spoons and forks).

2. Plan the picnic. Ask students for ideas about how they can pack a lunch that will produce the least amount of garbage. Explain that they will be making a friendship salad the day of the picnic and that they can contribute one or two pieces of fruit if they want to.

3. Send the letter shown on the previous page to parents telling them of the picnic and asking for volunteers.

Day Two

4. On the morning of the picnic, discuss garbage and cleanup. Point out that some things will need to be thrown away even though the picnic was planned and choices were made so that there would be little garbage. Show students the buckets or cans you want them to use for all of the garbage at the picnic. Explain that one bucket is for recyclable containers, one is for leftover food that can't be saved, and one is for other garbage like paper and plastic. If there is water available at the picnic site, let students know that they can wash all dirty, reusable containers and utensils after the picnic.

5. One or more of the parent volunteers can help small groups of students wash and cut the fruit during the morning.

6. Remember to bring the three labeled buckets with you. Make sure students keep and sort their garbage after the picnic.

7. After lunch call the students together. Discuss what kinds of garbage are left over and what garbage isn't there because students made careful choices about what to bring. Make sure when the class leaves that no garbage is left at the picnic site.

After the Picnic

8. In the classroom put all of the food garbage from the picnic into the bucket for composting. You can layer the food with sawdust and dirt, if either is available. Make sure the cover fits tightly; open compost containers attract rodents and flies. Stir the mixture every three to five days for a couple of weeks. When most or all of it looks like dirt, use it. Add a little soil and plant flowers in it or mix it into the soil under a favorite tree. Let students know that compost is a kind of plant food; it contains many nutrients that plants use.

9. You or one of the parent volunteers can take the cans to the recycling center in your area. Discuss with the students where the cans are going and why it is better for the environment to recycle cans rather than throw them away.

10. Discuss with students what they did during the picnic that was good for the environment and good for people. Let students express their ideas and feelings. Discuss savings of paper (trees), plastic, and money.

11. Distribute paper and drawing materials and have students draw a picture of the picnic showing themselves and others doing something good for the environment. Older students can label their own pictures; younger students will need to dictate a sentence or two.

Discussion Questions:

What do you usually throw away after a picnic?

How could you pack a lunch for a picnic so you would have little or no garbage?

Why do you think people might want to use something that could be thrown away, even if they know it just makes more garbage?

Why is garbage bad for people, plants, and animals?

What kind of garbage was left over after the picnic?

What other kinds of garbage might we have had if we didn't plan an ecological picnic?

What choices did you and other class members make that were good for the environment? Good for people?

How can we turn a banana peel into a football? (Feed it to a pig.)

How can we turn an orange peel into a strawberry? (Compost it, then use the compost in a strawberry patch.)

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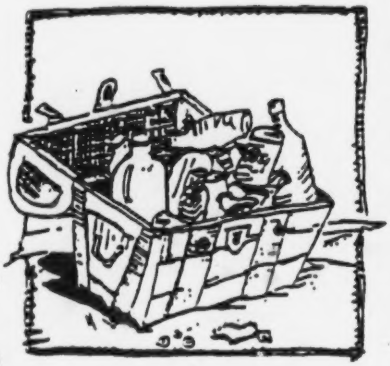
TREE AMIGOS

Recycling

This fact sheet was prepared with the assistance of the Institute for Local Self-Reliance. Neil Seldman, President of the Institute for Local Self-Reliance, is a member of Earth Day 1990's Environmental Advisory Council.

Why Recycle?

Recycling saves energy, natural resources and landfill space. In 1990, it is projected that Americans will throw away over 1 million tons of aluminum cans and foil, more than 11 million tons of glass bottles and jars, over 4 and a half million tons of office paper, and nearly 10 million tons of newspaper. Almost all of this material could be recycled, cutting down on the environmental damage caused by mining, logging, and manufacturing raw materials, while decreasing the amount of garbage being dumped. The average American generates 3.5 pounds of garbage every day for a national total of over 160 million tons per year. Over 80 percent of this waste could be recycled using existing technologies.



Global warming, acid rain, and oil spills are problems directly related to our extravagant use of energy. Three percent of our nation's energy is used to produce packaging materials, such as bottles and cans. By recycling aluminum it is possible to save 95 percent of the energy that it would take to manufacture new products from raw materials. In other words, throwing away an aluminum can wastes as much energy as if the can were half full of gasoline. Americans throw away about 35 billion aluminum cans every year. If all these cans were recycled, we would save an amount of energy equivalent to 150 Exxon Valdez oil spills annually. In 1988, Americans set an all time high by recycling 42.5 billion cans. This alone saved enough energy to supply power for the city of Boston for one full year.

For every ton of paper that is manufactured from recycled pulp, 17 trees are saved and 3 cubic yards of waste paper avoid being landfilled. Since paper comprises over 40 percent of our municipal waste stream, recycling could extend the lives of our existing dumps considerably. For recycling to work, however, it is important that there is a market for the new product. The U.S. uses about 40 percent of the world's newsprint supply, yet only 14 percent of this paper is made from recycled fiber. Recycled paper uses up to 64 percent less energy to manufacture than virgin paper and produces only one-quarter the air pollution.

At present, more newspapers are recycled than recycled newsprint bought, causing a glut in the market for recycled newsprint. Barriers to increased recycling include federal subsidies to the timber industry that make the price of virgin paper artificially low. A tax credit for those manufacturers who use recycled materials could offset this perverse incentive for using virgin materials. A worldwide paper shortage is creating opportunities for community economic development through small scale paper manufacturing plants located near the source of supply for waste paper. For every million Americans who recycle, some 1,500 manufacturing jobs are created.

> **"We are recycling not only to protect the environment, but for economic reasons as well. Disposal is simply too costly and too dangerous. The challenge is to redirect the flow of raw materials going to landfill into strengthening our declining local economies. The solution to pollution is self-reliant cities and counties."**
>
> *-Neil Seldman, President, Institute for Local Self-Reliance*

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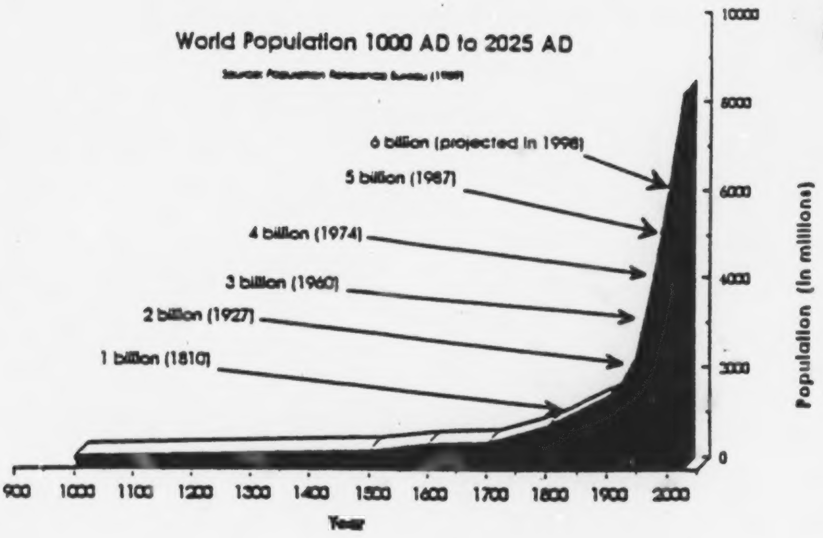
Vast areas of land in the United States have been cleared to support our population. Over 3 billion tons of topsoil are lost annually as a result of intensive farming and over-grazing. Large stretches of forest have been cut to provide wood and paper, leaving only five percent of our ancient (uncut) forests standing. In water poor areas, high rates of growth are leading to water diversion and depleted groundwater reserves. As urban areas expand, air and water pollution are amplified.

What You Can Do

- Write President Bush and let him know that you want the United States to take the lead in promoting sustainable population policies worldwide. President Bush; The White House; 1600 Pennsylvania Ave., NW; Washington, DC 20500.
- Write your elected officials urging them to support legislation to: fund family planning; develop better contraceptives; promote equality for women; and break the cycle of poverty.
- Write the World Bank and urge it to require that sustainable population programs be part of every nation's development efforts. Barber Conable, President; The World Bank; 1818 H Street, NW; Washington, DC 20433.
- Encourage small families by example and by educating others about the need to make environmentally responsible reproductive choices.
- Support efforts to limit the impact of growth in your local community.


World Population 1000 AD to 2025 AD

Source: Population Reference Bureau ([illegible])

For More Information

- Zero Population Growth
  1400 16th Street, NW, #320
  Washington, DC 20036
  (202) 332-2200
- International Planned Parenthood Federation
  902 Broadway, 10th Floor
  New York, NY 10010
  (212) 995-8800
- National Audubon Society
  801 Pennsylvania Ave., SE
  Suite 301
  Washington, DC 20003
  (202) 547-9009
- Population Crisis Committee
  1120 19th Street, NW, #550
  Washington, DC 20036
  (202) 659-1833
- The Population Institute
  110 Maryland Ave., NE
  Washington, DC 20002
  (202) 544-3300
- Population Reference Bureau
  777 14th St., NW, #800
  Washington, DC 20005
  (202) 639-8040
- Sierra Club
  Population Committee
  730 Polk Street
  San Francisco, CA 94109
  (415) 776-2211
- United Nations Population Fund
  220 E. 42nd St.
  New York, NY 10017
  (212) 850-5842
- Worldwatch Institute
  1776 Massachusetts Ave., NW
  Washington, DC 20036
  (202) 452-1999

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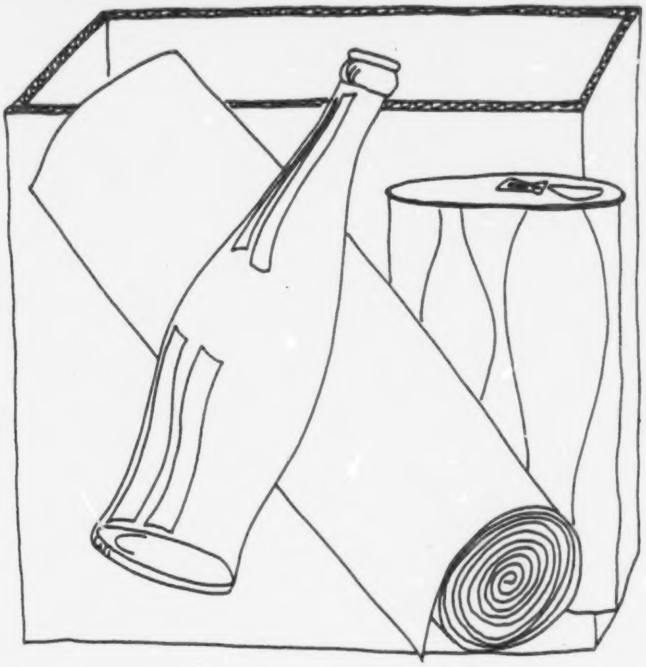

One Day Recycling Project

The above title is perhaps a bit misleading. The whole project could take a month or so depending on how much time it takes for families to accumulate a quantity of the particular material(s) designated for the project. What the title does signify is that rather than having bins set up and allowing drop off of materials daily there would only be one day designated as the collection day. At this time people would bring in all their accumulated recyclable material(s). The material(s) would be delivered to the recycling center or secondary materials handler on that same day. This project requires no storage time on the school grounds. This project could also serve as an indicator in assessing the possibility of organizing a continuous recycling collection.

Please check the section title "Selecting a Project" to make sure that a recycling project is feasible in your area. Also, see the whole school project titled "Recycling Year Round" for added information concerning some of the reasons why recycling is becoming increasingly more necessary. Below you will find the project outline.

- Determine recyclable material(s) to be collected.
- Check section on motivational ideas and selecting a project.
- Locate the best market for the material(s) in your area.
- Educate people in the required preparation of the material for recycling (flattening cans saves space).
- Line up transportation to the recycler (parents with trucks and vans, or perhpas businesses willing to loan trucks for the day) or perhaps find a recycler that could pick up the material(s).
- Storage bins should not be necessary as you can sort material(s) into the appropriate vehicles for transportation.
- Evaluate the success of the project.
- Discuss future 'one day' or continuous recycling projects.

For class ideas see 'Recycling Year Round' *Industrial Arts class would not need to design and construct storage bins.

Student council/club/booster - coordinate transportation to recycling center or secondary market.

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Recycling Year Round

Recycling is a very tangible, positive method of waste reduction. It is more than putting trash into a waste container or landfill. Landfilling takes the material out of its cycle of reuse. In addition, landfills are filling up at a rapid rate, additional land for this purpose is at a premium. So, in practicing recycling we can slow down the rate of filling current landfills and the need for additional space for new landfills. Few people like to live near a landfill, however, most agree that they are necessary. If these same people began to recycle conscientiously there would be less need for landfill space.

Other factors including energy and monetary savings are also good reasons to recycle. Beyond this, too, there is a savings in regard to the rate at which we would be using our natural resources. All of the above represent a few important reasons for the project outline which follows. This project is for the school that wants to have an **ongoing recycling project throughout the year.**

At this point consideration should be given as to whether your recycling project will include only waste materials generated by the school or those items generated within the students' homes. Also, before going any further, you should recheck the section titled 'Selecting a Project' to make sure that a recycling project is feasible in your area. Once that is finished continue with the project outline. Material for this outline has been adapted from the **Kent Environmental Council School Recycling Programs.**

Recycling of School Generated Materials

Ledger Paper

- Create awareness of recycling project through an assembly or presentations to particular classes which would include all students.
- Check section on 'Motivational Ideas'
- **Inside Collection of Ledger Paper including:** Notebook paper, mimeo ditto, manila folders, index cards, construction paper, bond paper, envelopes (no plastic windows) **not including:** ditto masters, treated paper, carbon paper, blueprint paper, taped paper, waxed or plastic paper. Post this list in each classroom. Check with your local recycler to be sure!
- Construction of or donation of (from businesses or local recycling center) collection barrels for each classroom.
- Construction of or donation of larger container or bin for school-wide storage until pickup or delivery by or to center.
- Set up system of daily collection of ledger paper from classroom either by agreement with janitor or commitment from clubs or classes.
- Set up bookkeeping system to record pounds collected, price per pound or 100 pounds, and of course a running total.
- Decide how the money is to be spent.

Aluminum Trays

- Check possibility of aluminum tray collection if used in your cafeteria.
- Check necessary preparation of trays to be acceptable for local recycler.

Household Generated Materials

- Develop a survey to be filled out by students concerning what they consider to be the most readily available recyclable material(s) in their homes.
- Check section on motivational ideas.
- Invite a guest speaker from a local recycling center to speak to the student body or select groups or take a series of field trips to a local center.
- Decide what materials will be collected (newspaper, cardboard, glass, aluminum, tin cans, plastic, etc.)
- Decide whether collection bins will be inside the school for students use only or outside for the public's use.
- Design and construct or seek donations from businesses for appropriate bins for collection and storage.
- Find a local recycler or secondary materials handler to pickup or receive your recyclables.
- Find out what the acceptable maximum or minimum weights are for the materials that you plan to recycle.
- Post 'How to Recycle' poster so material will be dropped off better prepared for recycling. Then, less processing will be required on the school grounds.
- Have a club, class or group of volunteer students with faculty or parent volunteer advisor organize and maintain the collection site.
- Keep records of expenses and money received through buy back program per material. Compute total profits or debits.

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Division of Labor:

English Classes: Create and write articles or P.A. announcements or flyers to put on bulletin boards or for students to take home.

Speech. Drama: Create recycling mini play for motivational assembly or to tour classes.

Industrial Arts: Design and construct storage containers or bins for recyclables.

Art: Design 'How to Recycle' poster or handbills for display or distribution.

Clubs/boosters/classes: Organize and maintain collection site.

Math/Bookkeeping: Set up bookkeeping system for expenses. money received. profits. debits-according to type of recyclable material. Keep track of time it takes to collect a sufficient quantity of material to take to the reycling center.

Science: Determine savings due to a recycling effort in regard to natural resources and energy.

Health: Survey possible problems in recycling cans and jars that have contained food.

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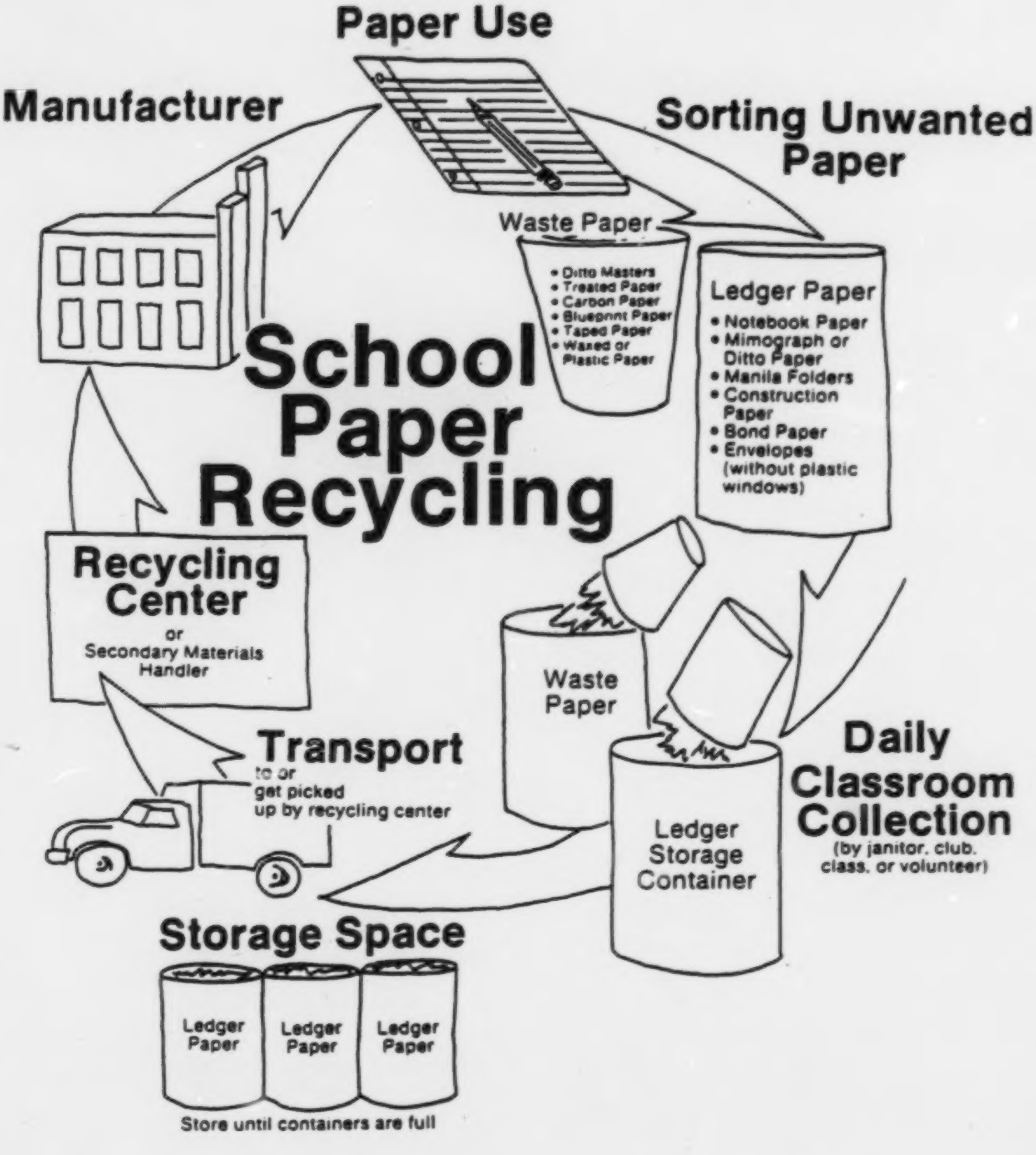
Paper Use
Sorting Unwanted Paper
Waste Paper
• Ditto Masters
• Treated Paper
• Carbon Paper
• Blueprint Paper
• Taped Paper
• Waxed or Plastic Paper
Ledger Paper
• Notebook Paper
• Mimograph or Ditto Paper
• Manila Folders
• Construction Paper
• Bond Paper
• Envelopes (without plastic windows)
Manufacturer
School Paper Recycling
Recycling Center
or
Secondary Materials Handler
Waste Paper
Daily Classroom Collection
(by janitor, club, class, or volunteer)
Ledger Storage Container
Transport
to or get picked up by recycling center
Storage Space
Ledger Paper
Ledger Paper
Ledger Paper
Store until containers are full

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TITLE RECREATION IN RECYLING

SUBJECTS Physical Education. Home Economics-Child Care. Drafting-Shop

OBJECTIVE To design an outdoor obstacle course or playground which uses materials commonly discarded. dumped and found in junk yards.

TIME FRAME 2 Weeks

ACTIVITY

1. Through class discussion and use of resource materials. students will develop guidelines and requirements for building an obstacle course or playground on their school grounds.*
2. Student will list "junk yard" materials with corresponding obstacle course or playground uses.**
3. Students will draw illustrations of individual sections of an obstacle course or playground equipment. including construction directions. "junk" items used. and directions for the course procedure or equipment use.
4. In small groups or as a class students will develop blueprints for the obstacle course or playground.
5. If possible students will present ideas to proper school officials and have the playground or obstacle course built—hopefully students will have an actual hand in building the course or playground.

MATERIALS Resource materials on playground and physical education or armed services obstacle courses and equipment.
Paper etc. required for illustrations and blueprint drawings

RESOURCES

OPTIONAL Present blueprints. illustrations etc.. to local Parks and Recreation department for possible construction in community parks.
Work with shop classes in construction techniques and requirements and possible design ideas.

***GUIDELINE IDEAS**

GENERAL: Safe—no sharp. rusty or easily breakable parts
Durable—withstand weather and rough use
Attractive—paint. arrangement etc. to prevent junk yard look.

OBSTACLE COURSE: Physical Challenge—coordination. speed. endurance. muscular strength.
Incorporate—running, jumping, climbing, throwing, crawling, etc.

**PLAYGROUND: Challenge appropriate to physical development of children.
Promote—creative play.
Include—climbing, running, swinging, sliding, sand box. etc.

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Crafts from Trash

Age: 5-12 years old

Goals: To help children learn that many items can have more than one use, and that the longer you keep an item out of the waste stream, the better it is for the environment.

Background:

Many containers can have their "lives" and usefulness extended by finding creative ways to reuse them. In this activity, children will learn to make toys, musical instruments, piggy banks and bird feeders from common household trash.

Recycle for the Birds

Materials:

clean household containers:
  milk, detergent and bleach bottles
  milk cartons
  coffee cans
  pie tins
  onion sacks
mustard jar lid (for tracing circles)
sticks or dowels (for perches)
knife
hammer
nails
wire cutters
pencils
ruler
light wire
coat hangers

Procedure:

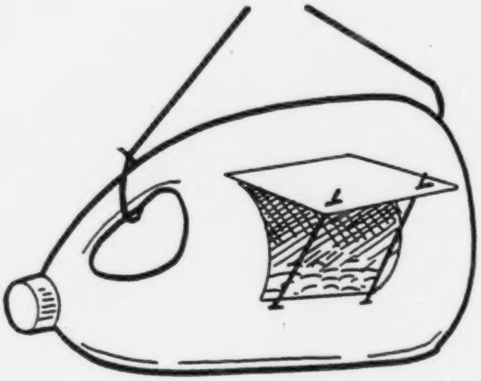
1. Create bird feeders out of clean household containers using the drawings for models. Assist younger children with the cutting. Remember to punch small drain holes in the bottom of the containers to let rain water out.

2. Discuss the proper locations for installing the feeders with your group and the types of bird feed to put in each container. Inform them of their responsibility for maintaining a continuous supply of food once feeding is started and the importance of keeping the feeders clean.

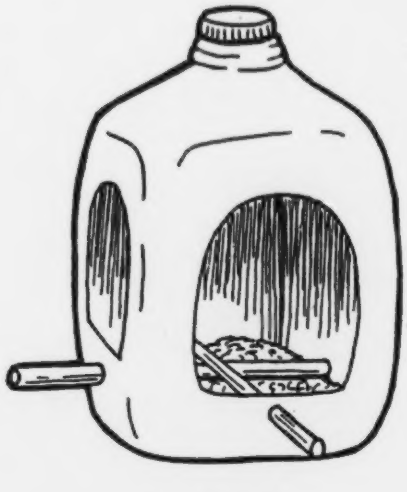
3. Discuss the importance of reusing materials and develop a list of common items that can be reused and the new use(s) for each.

Going Beyond:

- Design and create bird houses out of natural or man-made containers.
- Provide string, old yarn, baler twine, cloth strips, etc. for nesting materials. Wind these through an onion sack and hang the sack on a coat hanger.
- Donate feeders to nursing homes and maintain them.

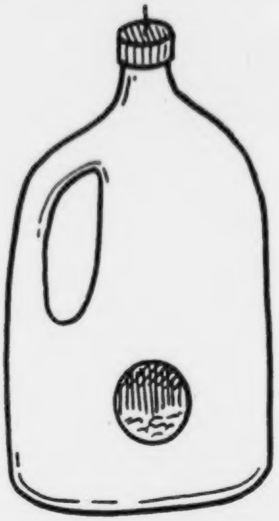


Bleach bottle feeder

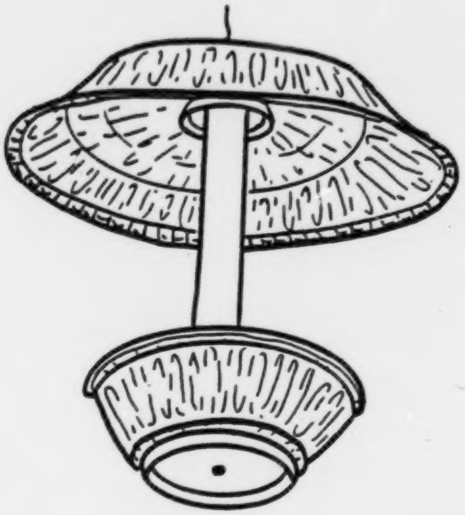


Milk jug feeder

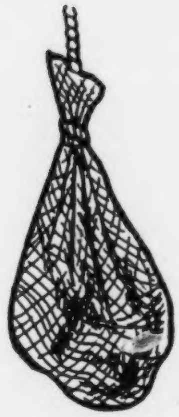
"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707



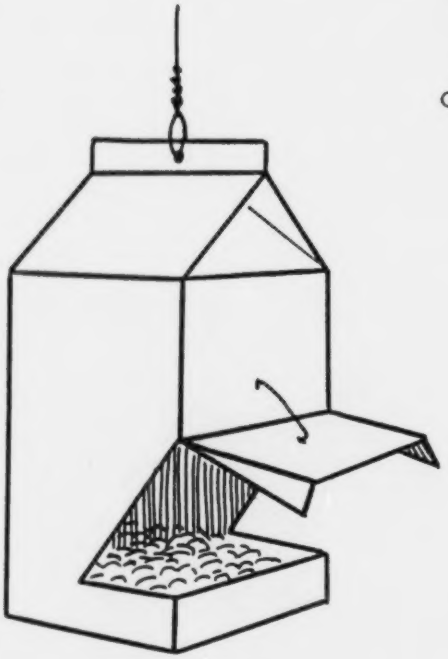
Detergent bottle feeder



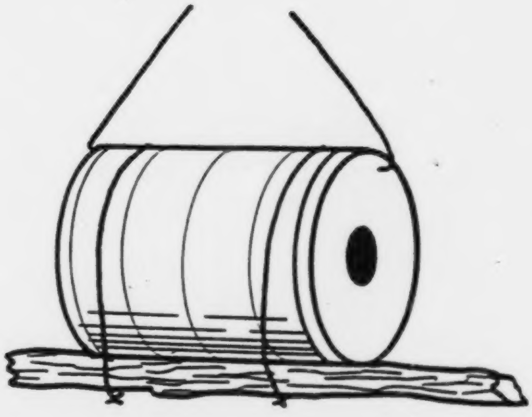
Pie plate feeder



Onion sack suet feeder



Milk carton feeder



Coffee can feeder

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Bureau of Information and Education
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Madison, WI 53707

Plastic Bottle Pig Bank*

Materials:

plastic bleach bottle
4 corks per bottle
1 pipe cleaner
construction paper
glue
scissors
red marker

Procedure:

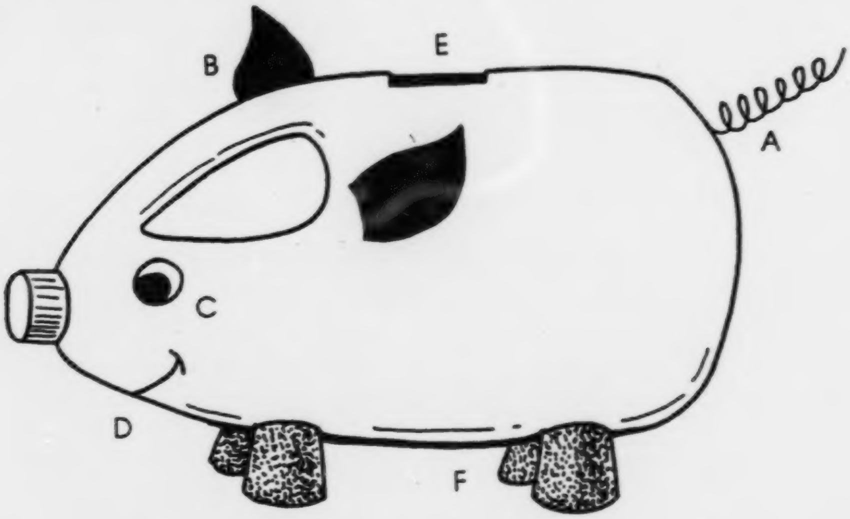
1. Encourage children to bring plastic bottles and corks with them. These could be their "entrance tickets" to your craft room. Save plastic bottles yourself for the occasional "I forgot my bottle"ers. Friends Groups could also be asked to save plastic bottles.

2. Guide your class through the process of "pig construction" using demonstrations and the following directions:

- Rinse bottle out thoroughly.
- Make the pig's tail by twisting a pipe cleaner around a pencil and then slide it off.
- Lay bottle on its side with handle facing up and with neck of the bottle representing the pig's snout. With tip of scissors poke a hole for pipe cleaner "tail" at the base. Stick pipe cleaner "tail" into the hole and affix with glue. (See "A" on drawing). Younger children will need help puncturing and cutting the bottles.
- Draw two ears on the construction paper and cut them out. Glue them on each side of the bottle. (See "B" on drawing).
- Draw and cut out two eyes and glue them on each side of the bottle just above the snout. (See "C" on drawing).
- With red marker, draw a mouth below the snout. (See "D" on drawing).
- Cut out a slot, large enough to fit a fifty cent piece in, on top of the bottle between the ears. (See "E" on drawing).
- Glue four corks on the bottom of the bottle for legs. (See "F" on drawing).

Going Beyond:

- Point out to the children that they just took a piece of trash and made it into a treasure. Ask them to think of other objects that can be reused in ways different from their original purpose. Ask them how they are helping the environment by reusing items.



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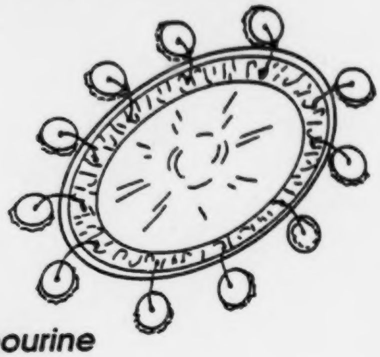
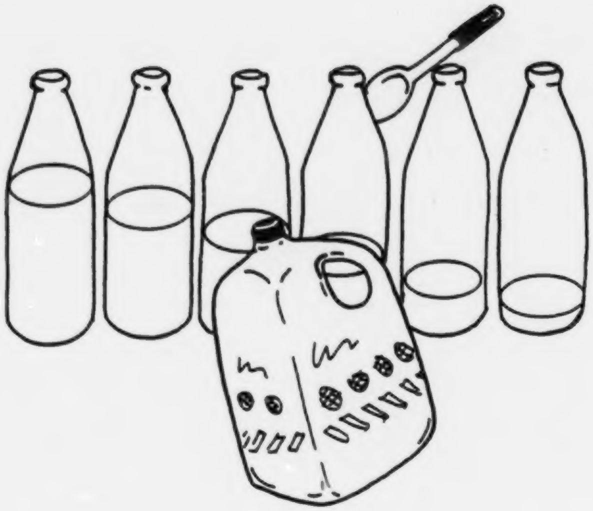
Musical Instruments*





Tambourine

Materials:

pie tin
bottle caps
string or yarn in 3" pieces

Procedure:

1. Punch holes around pie tin with hammer and nail.
2. Punch one hole in each bottle cap.
3. Put a string through one hole in pie tin and one bottle cap and tie a knot in each end of the string.
4. Continue stringing each hole with a bottle cap.

Bottle Xylophone

Materials:

8 used glass bottles of uniform size
water
wooden and metal spoons

Procedure:

1. Put bottles in a line without touching each other.
2. Leave the first bottle empty.
3. Put a small amount of water in the 2nd.
4. Put more water in each bottle until the last one is full.
5. Hit each bottle with a wooden spoon and listen to the tones. Try using a metal spoon and hear the difference.

Milk Carton Shaker

Materials:

gallon plastic milk carton with top
dried beans or sand
crayons

Procedure:

1. Design the outside of the container with crayons.
2. Put dried beans or sand in bottom of container (only small amount needed)
3. Screw on lid.

Going Beyond:

- Use these instruments with the Sing Along found in this booklet.
- Discuss how the instruments were made from items that normally would have been trash.
- Use your imagination to think of other instruments that can be made from trash.

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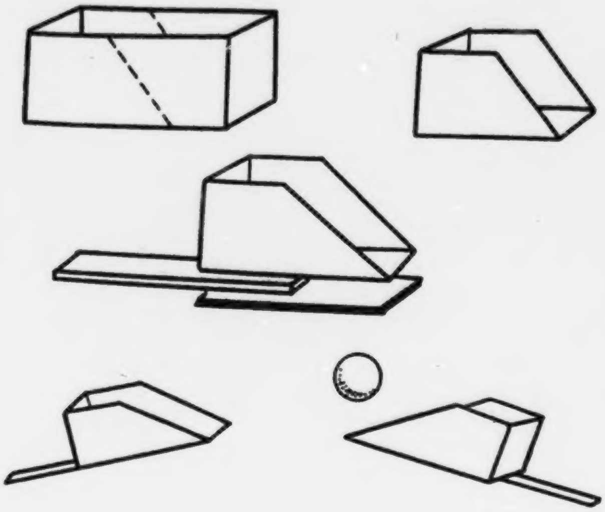
Recycled Toys

Scoop Ball

Materials: (per set of Scoop Balls)

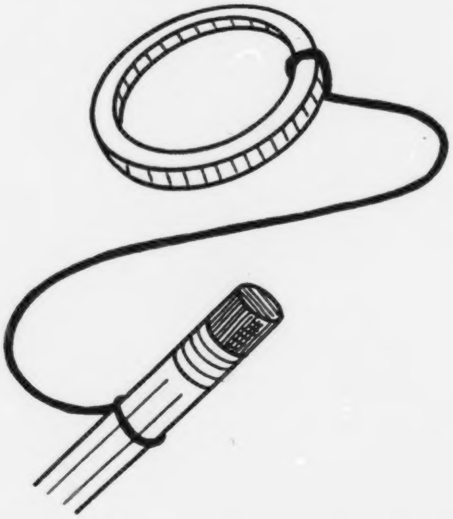
- 2 shoe boxes
- glue
- 2 thin strips of wood (approx. 7" x 1") (used paint stirring sticks work well)
- 2 cardboard strips
- ball (tennis, whiffle or racquet ball would work, or be resourceful and use a ball of used tin foil)



Procedure:

1. Children should be told in advance to bring a shoe box and plastic or card board lid with them.
2. Cut two shoe boxes into scoops as shown in the diagram.
3. Glue a thin strip of wood to each scoop for a handle.
4. Reinforce the handle by gluing an extra piece of cardboard to the bottom of each scoop.
5. Allow the glue to dry.
6. Play ball! Players stand opposite one another and toss the ball back and forth with their scoops. No hands can touch the ball. Pairs can compete against other pairs by seeing who can make the most consecutive catches.

Ring Catch



Materials:

- 1 pencil per person
- 1 lid from an ice cream, margarine, or sherbet container
- scissors
- string

Procedure:

1. Cut out the center of the lid.
2. Tie the string from the lid to the pencil.
3. Swing the pencil back and forth and try to catch the ring on it.

Going Beyond:

- Discuss with the children how they just turned a piece of trash into a fun toy! What else could they make with their trash? Discuss how using the lids over again saves our landfill space. It also saves natural resources by not having to use virgin materials to build new toys.
- Bring in a commercial set of scoop balls. Discuss the difference in price, the difference in materials (degradable versus non-degradable), and the similarity of performance for the two styles of scoops.

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Fireplace Logs from Newspapers*

Age: 8-adult

Goal: To help people learn that energy can be recovered from trash.

Background:

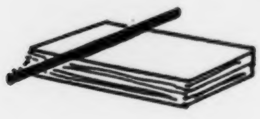
Reducing consumption, reusing materials, recycling resources, composting food and yard wastes, recovering energy through incineration and landfilling are the alternatives that we have for handling our trash. Incineration may be as controversial as landfilling, but when done as part of an energy recovery system with good environmental controls, it is a viable alternative. In Wisconsin we annually landfill enough energy in our trash to heat 300,000 homes; this is a tremendous waste of resources. Many communities are now looking at waste-to-energy plants as a sound way to help solve their trash problems. They are doing it as a fifth step after reducing, reusing, recycling and composting. If there is not a market for newspaper in your area, turn your newspaper into fireplace logs for energy.

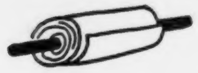
Materials:

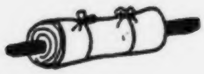
- container(s) large enough to hold several soaking newspaper logs
- newspapers
- used twine or string
- broomsticks
- scissors
- water

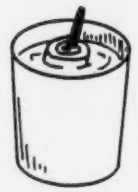
Procedure:

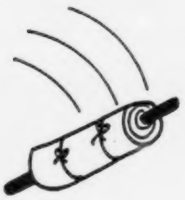
1. Take eight pages of newspaper and lay them unfolded on a table or floor lengthwise. Lay the broomstick at the top of the paper.
2. Tightly roll the newspaper around the broomstick to about 8 inches from the end. Overlap another 8 pages and continue rolling until you have a good size log.
3. Tie with used string or twine (3 inches from each end).
4. Soak overnight in water. The water will break down the paper's fibers and reduce the amount of fly ash when the logs are burned.
5. Take logs out of the water and bang them on the ground to pack the paper.
6. Remove the broomstick and dry thoroughly (on racks if possible).

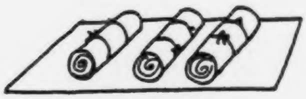












Going Beyond:

- Discuss where the energy that is stored in the newspaper comes from.
- Sell logs as a fund raiser.
- Use old continuous fold computer paper instead of newspaper.

* Adapted from **Recycle Alaska Activities Handbook**, State of Alaska, Department of Environmental Conservation, Pouch O, Juneau, Alaska 99811

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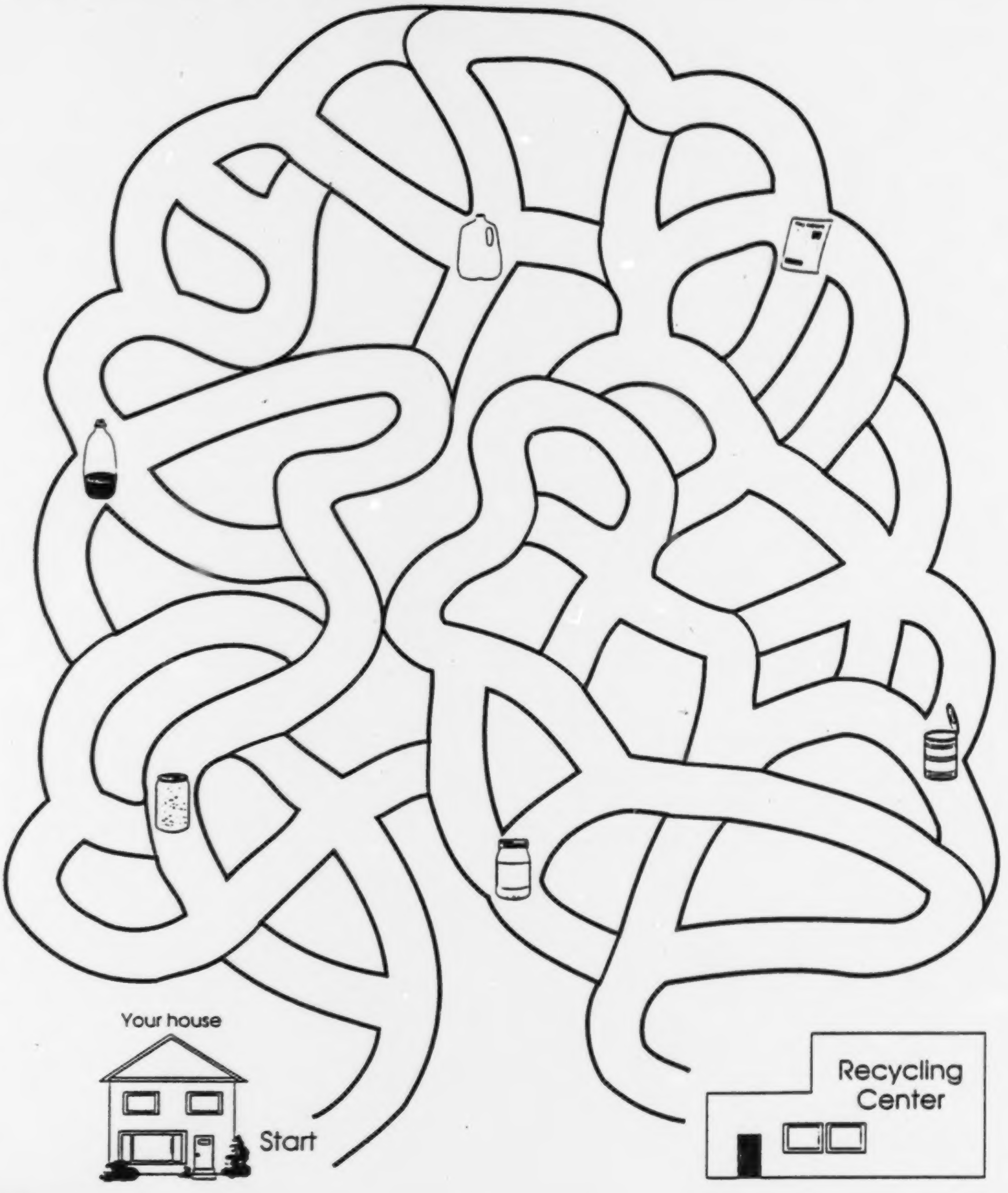
Recycling Maze

With a pencil or crayon, follow the path from your house to the recycling center. Collect all six recyclables along the way. Do not cross any lines.



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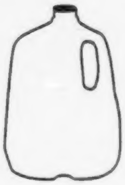
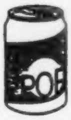
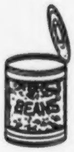
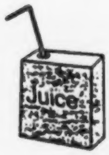
Trash It Or Recycle It

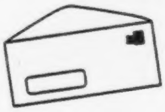
Draw a line from each item to the barrel it should go in.

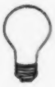


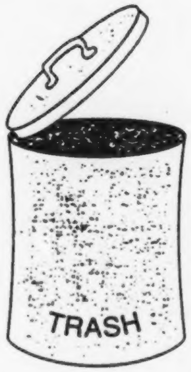


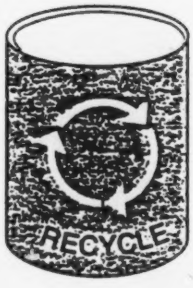


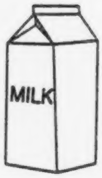


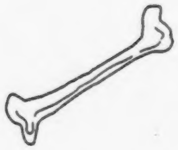


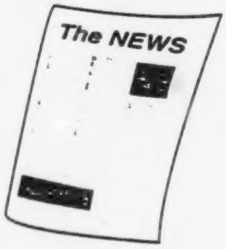


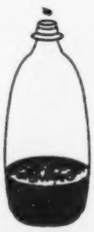


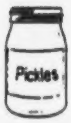












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CAN YOU I.D. YOUR CAN?

OBJECTIVE: Students will learn how to tell the differences between aluminum, tinned and bimetal cans.

SUBJECT: Science

SKILLS: manipulation, observation, comparison, identification.

MATERIALS: samples of aluminum, tinned and bimetal cans, magnets.

PROCEDURE:

1. If you have not already done so, discuss how waste is reduced by recycling.
2. Tell students that cans are recyclable, but that some are much easier to recycle than others. Hold up samples of the three major types of cans: aluminum (i.e., soda cans), tinned—these are really 99 percent steel with a thin coating of tin (i.e., soup cans) and bimetal (i.e., often tuna fish cans, small apple juice cans, and tennis ball cans are bimetal). Explain that bimetal cans are cans that have an aluminum top and a steel body. "Bimetal" does not refer to a can that has two metals combined to form an alloy.
3. Note that, at first glance, these cans are very similar in appearance, but that it is important to tell the difference because the bimetals are not easily recyclable, and we should therefore avoid buying these. It is also important to be able to identify the type of can because different types need to be separated before being recycled.
4. Explain and demonstrate to students the following ways to tell the differences between metals:
   a. *magnetism*
   Hold up a magnet. Ask for a show of hands of those who have experimented with magnets. Did they notice the things that magnets will attract? Explain that magnets are pieces of iron or steel that can attract iron or steel. (This property may be naturally present or artificially induced.) Experiment with objects to show some of the metals the magnet will attract and others that are not attracted.
   Demonstrate that magnets attract tinned and bimetal cans, but not aluminum cans.
   b. *appearance*
   Pass out can samples. Ask class to point out the differences they see between the cans (i.e., weight, seams, color, shininess). Tell them that bimetal cans look almost identical to aluminum cans. Check background information for details. It is best to compare the cans at the same time to see some of these differences.
5. Set up a station in the room so that one person or one group of students at a time can practice separating cans using magnets and observing the above differences. (You may want to provide a magnifying glass.)

EXTENSION:

1. Construct a machine to flatten aluminum cans.
2. Research and discuss how energy and pollution are reduced by recycling metals.

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COLLAGE—JUNK TO ART

OBJECTIVES: Students will recognize that:

- "trash" items may be adapted for functions other than their primary purpose.
- "trash" often has interesting shapes, color, texture and patterns.
- visual art has its origins in natural and man-made environments.

SUBJECTS: Science, Art, Language Arts

SKILLS: artistic creating, manipulating, analyzing, researching

MATERIALS: cardboard panels for mounting (one for each student), glue, paints, brushes, newspaper (students bring in), magazines, trash items.

PROCEDURE:

1. Before the lesson, have the students collect samples of trash and place in bag/box in room.
2. Invite students to show examples of particularly interesting colors, textures, or shapes they have found.
3. Show and discuss pictures or examples of assemblages. Emphasize art elements essential for aesthetically pleasing products. (Color, texture, pattern, rhythm, compositional balance. Ask art teacher for assistance.)
4. Students will analyze components and speculate about origins and "life stories" of assemblage parts.
5. Assist students in composing their collages.
6. Frame or mat and post student work.

EXTENSION:

1. Examine how other cultures use things that might be considered trash to make amulets, totems, ceremonial items.
2. Have the students select a type of litter and develop a list of different ways that particular item could be used.
   Option: Have the students "create" some of the items on their list.
3. Work in groups to research the background of the assemblage and present findings to the class orally.
4. Have students design and assemble a 3-dimensional sculpture of collected litter.

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COMPOST—A NEW BEGINNING

OBJECTIVES: Students will learn the basics of composting, principally the aerobic and anaerobic decomposition of vegetative waste.

Students will learn how composting reduces in mass and volume vegetative waste and turns it into a usable product which can be used as a soil amendment in the garden.

SUBJECTS: Science, Vocational Agriculture

SKILLS: observing, recording, researching, interpreting, experimenting.

MATERIALS: 5-gallon buckets (4), grass clippings, vegetable and fruit peels, weeds, hay, sawdust, coffee grinds, thermometer, bloodmeal.

PROCEDURE:

1. Have the class research "composting"—defining the terms aerobic and anaerobic.
2. Discuss the reasons why composting is important, i.e., it is a solid waste management tool and it turns vegetative waste into a usable soil amendment for the garden.
3. Drill or poke holes in the sides of 3 of the 4 buckets, near the bottom.
4. Set up the following conditions in each bucket:

Compost bucket #1
Compost which is low in nitrogen.
— Place mostly leaves and some vegetable and fruit peels in the bucket.
— Moisten, do not soak.
— Turn over regularly, once every 3 days for the first 2 weeks, then once per week.

Compost bucket #2
Compost without enough moisture.
— Place a mixture of grass clippings (high in nitrogen—make sure the grass clippings are not very wet), leaves, vegetable and fruit peels in the bucket.
— Do not water.
— Turn regularly.

Compost bucket #3
Compost without adequate air circulation.
— Place mostly grass clippings (high in nitrogen) in the bucket.
— Place a mixture of leaves, vegetable and fruit peels in the bucket.
— Keep moist.
— Do not turn.

Compost bucket #4
— Layer leaves, vegetable and fruit peels, and a small amount of grass clippings in the bucket.
— Keep moist.
— Turn regularly.

Keep a daily record of the temperature of each pile.

After a few weeks, discuss the results.
— Which finished compost is dark and crumbly with much of the original appearance no longer visible? Did compost bucket #4 produce the best compost?
— What are the essential ingredients to proper composting?
— How does composting reduce the amount of vegetative waste?
— Which compost piles became anaerobic (without oxygen)? Did the anaerobic piles smell bad?

*Keep buckets on paper or protective floor covering.

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DON'T JUDGE A PRODUCT BY ITS WRAPPINGS

OBJECTIVES: Students will be able to recognize how they are influenced to buy products based upon packaging.

Students will be able to determine if products are properly packaged.

SUBJECTS: Science, Social Studies, Consumer Education

SKILLS: observing, hypothesizing, critical thinking.

MATERIALS: variety of cereal boxes, 2 apples, ribbon, no-name cereal box.

PROCEDURE:

1. Bring two apples to class and a fancy bow. Show the apples to the students, placing the bow on one of them.
   - —Ask the students which one they would like to buy.
   - —Why do you want one apple over another?
   - —How do people package things (products) so that it makes you want to buy them?
2. Have the children bring in a (empty) cereal box. The teacher should supply a "no-name" brand if one isn't brought in.
3. Display the boxes and take a survey of students' preferences of the available samples.
4. Discuss with the students why they selected a particular sample (packaging, promotional gimmick, taste)

EXTENSION: Compare sizes of packages; small individual boxes vs. large economy size. Open box and measure the box area of both to analyze differences of size per portion.

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DRESSED FOR THE OCCASION

OBJECTIVES: Students will recognize that packaging is essential.
Students will understand that nature packages its products.
Students will be able to identify biodegradable and non-biodegradable packaging.

SUBJECT: Science

SKILLS: observing, analyzing.

MATERIALS: bananas, egg, paper towels, plastic, aluminum, glass.

PROCEDURE:

1. Put on the board, "Nature's Packaging" and ask the students if they know what it means.
   - —discuss/list the answers that will come up
2. Peel a banana and ask students if they would buy bananas without the peel.
3. Ask the students if they would buy an egg without its packaging.
4. Put the word "biodegradable" on the board and ask the students what they think it means.
5. Put the word "non-biodegradable" on the board and ask what the students think it means.
   - —provide examples of each biodegradable (paper towels) and non-biodegradable (plastic, aluminum, glass), and discuss why the items are biodegradable or not.
6. Ask students to bring samples of:
   - —"Nature's Packaging": coconuts, peanuts, oranges, etc.
   - —packaging that could be reused or would biodegrade if discarded: returnable bottles, waxed paper, waxed milk cartons, pottery (in early times, most packaging was of this type: pottery jugs, woven baskets, animal skins, etc.)
   - —excessive or difficult-to-recycle packaging: plastics, styrofoam, plastic milk jugs, laminated packaging, etc.
7. Divide the class into 3 groups, one for each category, and have them sort the items into the appropriate groups.
   - —discuss what the "packages" are made of and where they came from (i.e.—trees, oil, etc.)
   - —discuss the good and bad features of each type.
   - —ask the students—"Could Nature's Packaging be substituted for any other product? Why?"

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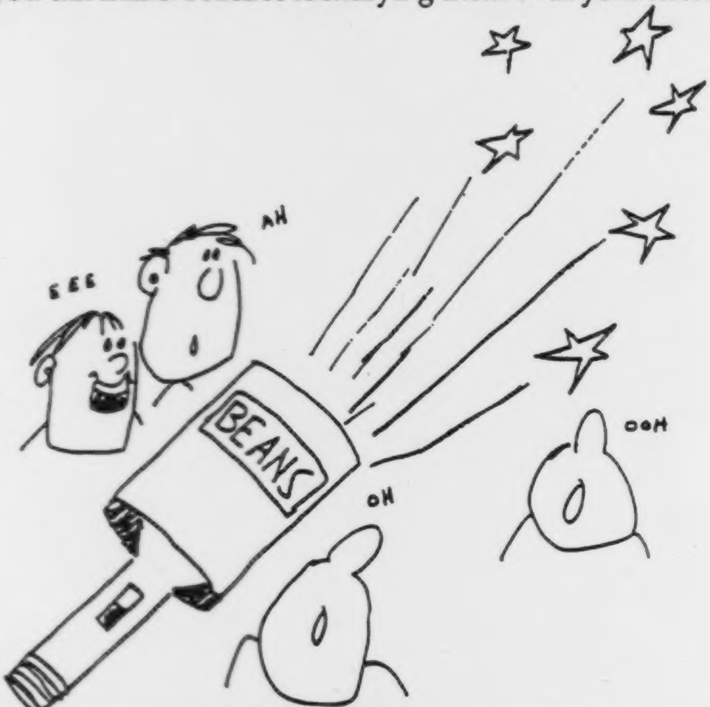
Arts and Crafts - Planetariums

Materials needed:
- Empty cans
- Several plastic lids that fit the can
- Black paint
- Flashlight
- Pencil

Directions:
1. Remove both ends of the can.
2. Spray plastic lids with black paint.
3. With a pencil, draw the constellation you wish to see onto the lid.
4. Punch out the star points on the lid.
5. Snap the lid onto the end of the can. Shine the flashlight through the other end and the constellation with project onto the ceiling. Be sure the room is dark. If your constellation is reversed, you will need to turn the lid over and try again. The more lids you have, the more constellations you can make. Practice identifying them with your friends.



"Reduce, Reuse, & Recycle Activities For All Grades"
Waste Education Clearinghouse
Office of Waste Managements
1350 Energy Lane
St. Paul, MN 55108

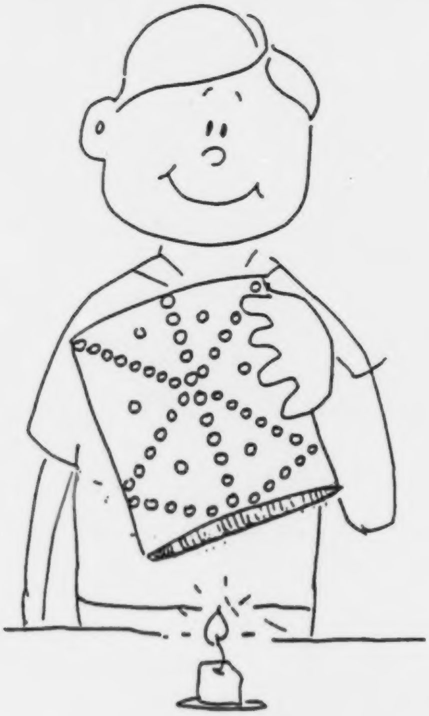
Arts and Crafts - Tin Can Lanterns

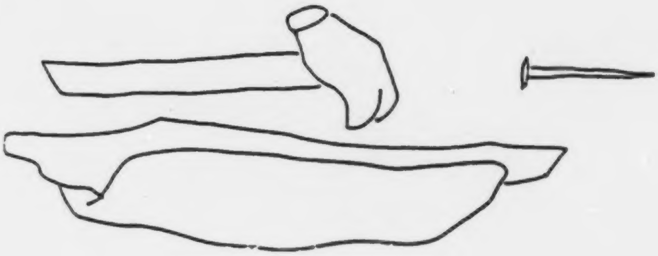
Things you will need:

- Large can with one end removed
- Nail
- Hammer
- Water
- Small candle (votive candle in a glass jar works well)
- Towel
- Crayon or felt pen to mark pattern

Directions:

1. Draw design all around can.
2. Fill the can to 1/4 inch from the top with water. Place the can in a freezer for two days so the ice can get hard.
3. Place the can filled with ice on a towel (to soak up drips as ice melts). Hammer evenly spaced holes through the lines of the pattern.
4. Allow ice to melt. Place can over candle to make pattern glow.





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Arts and Crafts - Monster Markers

A creative way to recycle empty deodorant bottles.

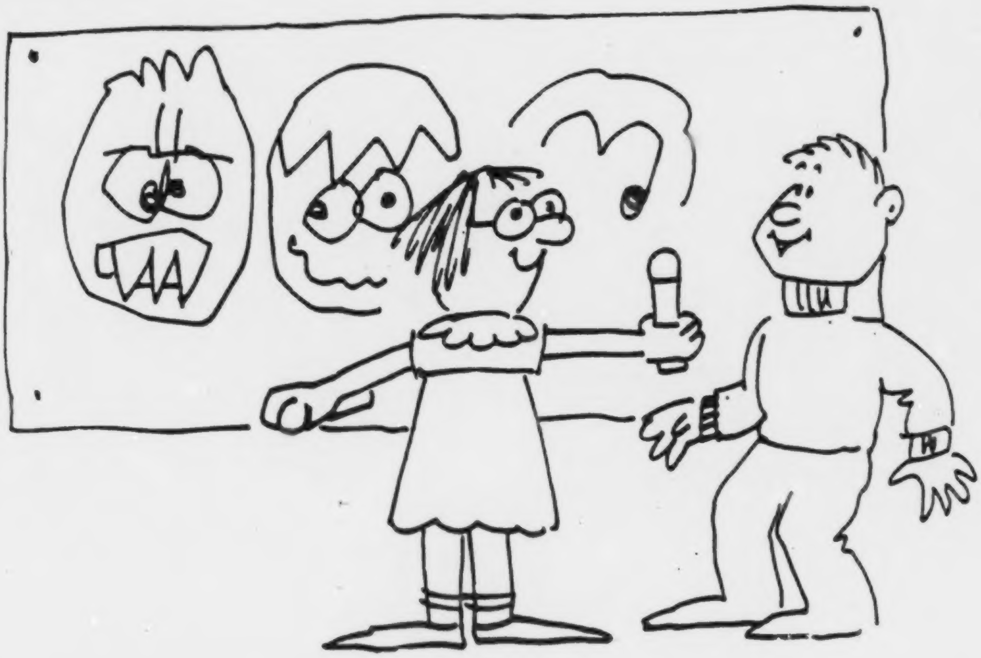
Materials:
	Empty roll-on deodorant bottles
	Poster paint

What to do:

1. Take the deodorant bottles apart. Wash well.
2. Mix up some poster paint. Get out all the lumps. It should be as thick as cream.
3. Pour the paint into the bottle.
4. Put the roll-on cap back on. Draw away.

Be sure to put the outer cap back on when our are finished.

This idea comes from a book called The Wild Inside - The Sierra Club's Guide to the Great Indoors by Linda Allison.



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Arts and Crafts - Garden Hats

You can make a cowboy hat, beach bonnet or a hat to keep the sun off your head when you're working in your garden.

It's a fun way to recycle newspapers, too.

Things you will need:

- Old newspapers
- Liquid starch
- A bowl, big enough to fit on your head
- Poster paint
- Brush
- Scissors

What to do:

1. Cut at least six large circles from open sheets of newspaper.
2. Lay one sheet at a time over the bowl and paint it with the liquid starch. The starch will hold the layers together and make the hat stiff.
3. After adding all the paper layers, shape the brim while the starch is still wet.
4. Let dry.
5. When the hat is completely dry, use your scissors to trim the edges. Paint the outside with poster paint. You can even decorate it with flowers, ribbons, or whatever you like.

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TRASH OR TREASURE?

GOAL: To have students find out why, how and where they should recycle or reuse what they typically throw away.

PROCEDURE:
1) Is there anything else you can do with what you throw away? List your ideas. Most of them will fit into one of the following four categories: reuse, recycle, recover energy, landfill. Write these four categories on the board. What trash items might fit best into each category? List them under the proper category heading.

2) Do a) and/or b), then answer the discussion questions:

a) To the teacher: *Give each student a copy of the following checklist to fill out, or put the list on the board and work through it as a group. (A copy of the checklist is available in the educational packet).*

Directions: Put an X next to the items you threw in the wastebasket this week.
______Paper bag
______Newspaper
______Book
______Magazine
______Paper milk carton
______Other paper
______Napkin
______Aluminum can
______Apple core
______Old clothes
______Plastic milk carton
______Tin can
______Glass jar
______Gum wrapper
______Orange peel
______Plastic bag
______Broken toy
______Grass clippings
______Other

TREE
AMIGOS

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Now circle all the items you think could have been reused or recycled.

Discuss:

- What items did you circle?
- How could you have reused items?
- Did you wonder whether the napkin was paper or cloth? What difference might this make?
- What could you have done with the recyclable items?
- What could you have done with apple cores and orange peels?
- Which items are difficult to reuse or recycle? Why?
- Should we as a society be making products that aren't reusable or recyclable?
- Should items that are wrapped in difficult-to-dispose of packaging cost more?
- Did any of your classmates reuse or recycle any items you circled?
- How did they reuse or recycle the items?
- Was reusing or recycling them easy to do? Why or why not?
- What do you think happens to the items you didn't circle?

b) Sort the items that your class threw out in one day into the following categories: reusable, recyclable, other. Discuss:

- Why did you place each item in the category you chose? Does your class recycle any of the items?
- Should your class recycle them? Why?
- Are there some items your class could recycle but doesn't? Why doesn't your class recycle them?
- Are there places in school aside from the classroom where you discard trash during the day? Think about how much food and how many food wrappers, cans and bottles you discard at lunch, how many paper towels you use to dry your hands, etc.
- What happens to the items that aren't reusable or recyclable?

3. Investigate where in your community you can take items to be reused or recycled.

- How can you find out about local recyicing programs? (Contact: Illinois Environmental Protection Agency, Illinois Department of Energy and Natural Resources, local natural resources and environmental groups, glass manufacturers, recycling businesses and municipal public works departments)

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- Make a list with the following information about the businesses or organizations that recycle: name, address, telephone number, materials recycled, hours of operation, whether the organization will pay you for materials, any other useful information.

4. Investigate and discuss:
- What are some advantages of recycling? (Conserves natural resources, saves energy, protects the environment, can make money, creates jobs for people involved in recycling and reduces our dependence on imported materials.)
- What are some disadvantages of recycling?
- What are the pros and cons of energy recovery and landfilling?

5. Brainstorm the steps your class might take to design and implement a recycling project for your classroom or school. Select a project that is feasible. For example, collect and recycle paper from the school's copy machine and classrooms. Who can you contact to help you with your project?

6. Consider doing your project!

Pre- and Post-Activity Questions:
- *What is recycling? What are reuse, energy recovery and landfilling?*
- *What types of solid waste can be recycled, reused, recovered or landfilled?*
- *What can you do in your school to recycle solid waste?*

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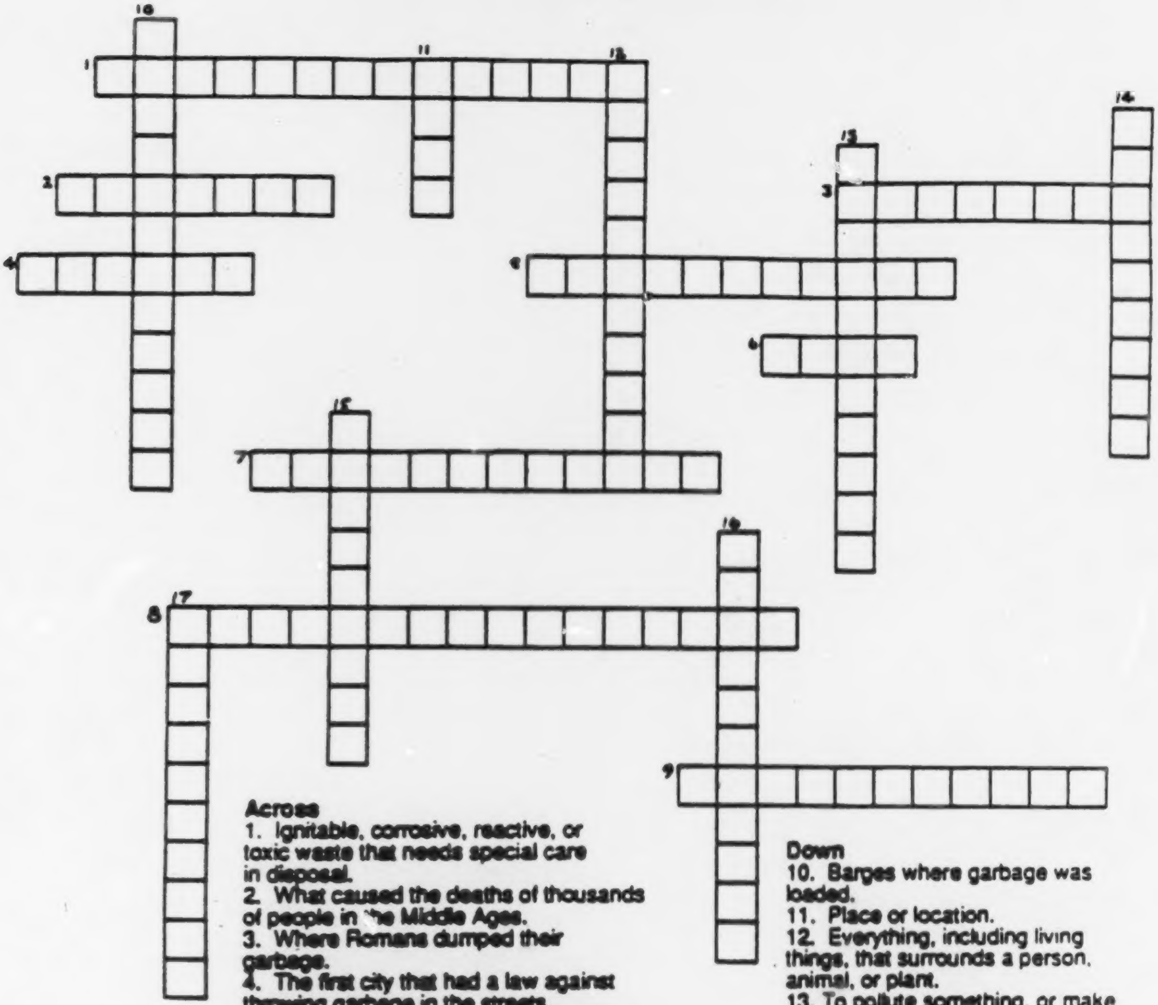
Activity

Name_______________

A Trash Trivia Crossword Puzzle



Across

1. Ignitable, corrosive, reactive, or toxic waste that needs special care in disposal.
2. What caused the deaths of thousands of people in the Middle Ages.
3. Where Romans dumped their garbage.
4. The first city that had a law against throwing garbage in the streets.
5. The supply of water under the earth's surface that forms natural reservoirs.
6. This city had a public health administrator by A.D. 14.
7. A system such as a spaceship or Earth in which energy, but not matter, can be exchanged with surrounding space.
8. Site where garbage and trash are taken and covered daily with a layer of soil.
9. Homes in this ancient city had trash bins and rubbish chutes.

Down

10. Barges where garbage was loaded.
11. Place or location.
12. Everything, including living things, that surrounds a person, animal, or plant.
13. To pollute something, or make it dirty.
14. Air, water, soil, trees, plants, minerals, wildlife and other things that make up the natural wealth of the earth.
15. Whatever makes land, water and air dirty and unhealthy.
16. Trash and garbage without enough liquid to flow freely.
17. A place where cities took their garbage composed of food waste.

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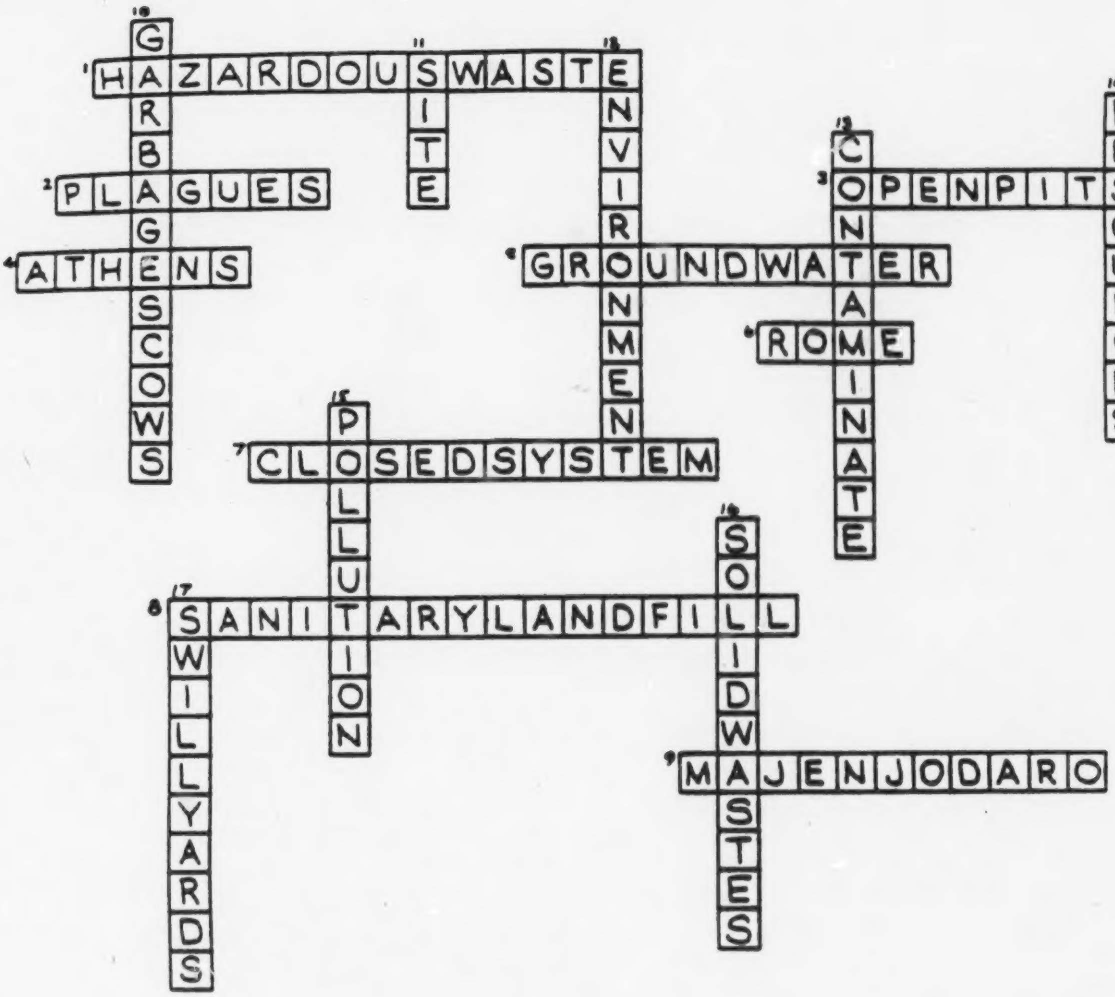
A Trash Trivia Crossword Puzzle


1 HAZARDOUSWASTE
2 PLAGUES
3 OPENPITS
4 ATHENS
5 GROUNDWATER
6 ROME
7 CLOSEDSYSTEM
8 SANITARYLANDFILL
9 MAJENJODARO
10 GARBAGESCOWS
11 SITE
12 ENVIRONMENT
13 CONTAMINATE
14 RESOURCES
15 POLLUTION
16 SOLIDWASTES
17 SWILLYARDS

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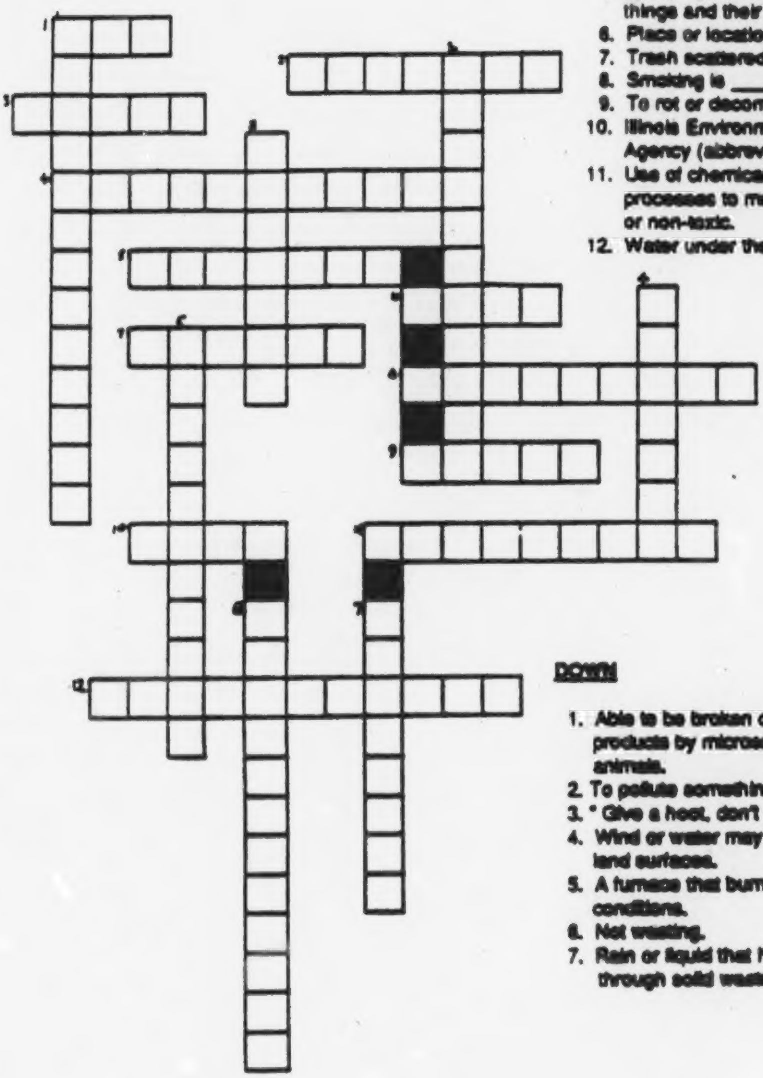
CROSSWORD PUZZLE FUN



ACROSS

1. To prohibit.
2. We should _______ aluminum cans.
3. Poisonous.
4. Learn to protect your ____________.
5. Studying relationships between living things and their surroundings.
6. Place or location.
7. Trash scattered about.
8. Smoking is _______ to your health.
9. To rot or decompose.
10. Illinois Environmental Protection Agency (abbreviate).
11. Use of chemical, biological, or other processes to make waste less toxic or non-toxic.
12. Water under the earth's surface.

DOWN

1. Able to be broken down into simpler products by microscopic plants and animals.
2. To pollute something, make it dirty.
3. " Give a hoot, don't ________!"
4. Wind or water may cause ________ of land surfaces.
5. A furnace that burns under controlled conditions.
6. Not wasting.
7. Rain or liquid that has percolated through solid waste.

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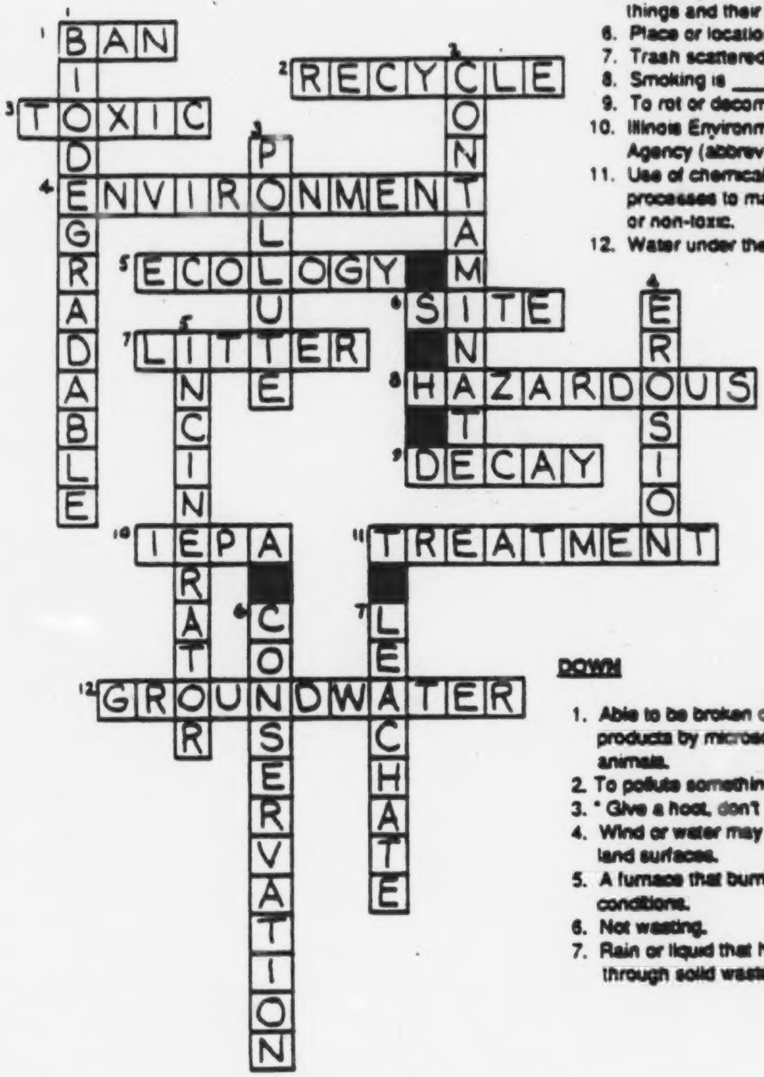
CROSSWORD PUZZLE FUN


1 BAN
2 RECYCLE
3 TOXIC
4 ENVIRONMENT
5 ECOLOGY
6 SITE
7 LITTER
8 HAZARDOUS
9 DECAY
10 IEPA
11 TREATMENT
12 GROUNDWATER
1 BIODEGRADABLE
2 CONTAMINANT
3 POLLUTE
4 EROSION
5 INCINERATOR
6 CONSERVATION
7 LEACHATE

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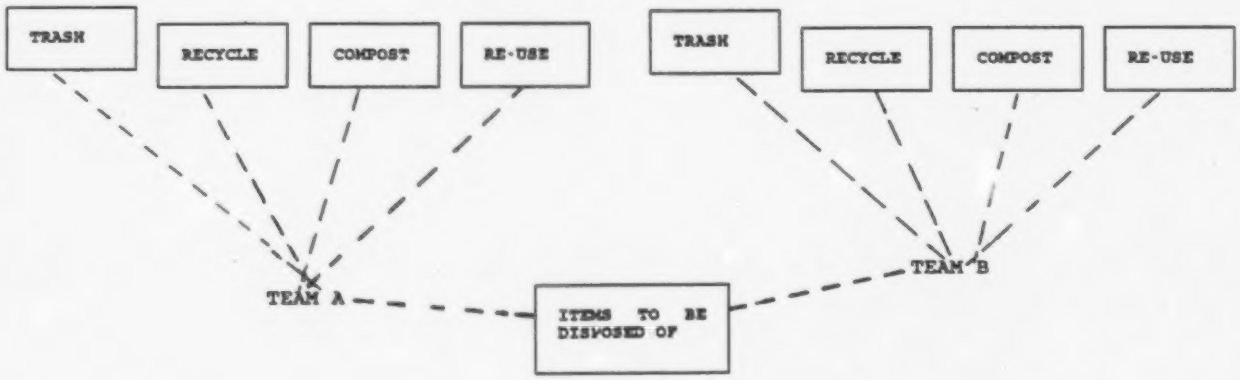
The Recycling Relay Race

Purpose: To encourage individuals (children and adults alike) to think quickly and to properly identify how waste is to be disposed of. It also provides physical activity for the participants.

Items Needed for Game: 6 buckets, cans or recycling containers
Label on each buckets (Composting, Recycling, or Reuse)
2 trash cans labeled "Trash"
Items that fit into the above categories
Poker Chips
1 person to monitor the cans

Process: Form tow teams. Set 3 buckets about 30 feet in front of each team. Set 1 of the large cans in the center of the two teams and the other large can in between each teams designated buckets. Line the teams up 30 feet from the 6 buckets. Fill the can in between the two teams with items that will fit into your selected categories. The two teams will then share the center can ad take items out and race to put them into the correct collection bucket. After successfully disposing the item the team member will receive a chip from the monitor and run back to the team and the next member will follow doing the same. After all the items have been properly disposed of the teams will add up their chips. The team with the most chips wins the game.



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92 POUNDS OF TROUBLE

Reading/Critical Thinking Activity

Students will recognize that the variety of plastic materials in use presents a major obstacle to recycling.

MATERIALS NEEDED

An assortment of plastic bottles (three per student, minimum), student worksheet (one per student)

BACKGROUND

In the past decade, waste plastics have doubled in the United States. Eleven million tons (that's 22 BILLION pounds!) go into our national trash heap. In New England, our share is one billion pounds – most of which will remain in our landfills virtually forever.

Eighty percent of all plastics now in use fall into the category of thermoplastics, which can be remelted and reformed somewhat like ice cubes can be melted and then refrozen. The remaining 20%, thermosetting plastics, cannot be reformed at all.

In 1984, an estimated 17 billion plastic bottles were produced. Approximately 40% of the plastic bottles are either soft drink bottles (whose chemical composition is referred to as PET) or milk bottles (made from a different plastic, HDPE). These bottles are the most easily recycled because there is a large quantity of each type available. Other plastic bottles (picture the variety of dishwashing soap or shampoo bottles) can only be recycled with matching plastics, as different polymers do not adhere to one another. This makes their recovery through recycling close to impossible.

As in other recycling efforts, the savings in resources through recycling plastics is significant. Plastics are part of the petrochemical industry, and the natural gas and crude oil used to make them are nonrenewable resources. Producing plastic from scrap (recycled) plastic saves 85-90% of the energy used in forming items from new materials. Incinerating plastics results in a 60-90% energy loss (some is saved in heat as the plastic burns), and the incinerator must then be cleaned out to neutralize the acid emissions. Problems with acid emissions and dioxin threaten another important resource, clean air.

IMPLEMENTATION

Have each student bring in three plastic items from home. Note the wide variety of items which fall under the category of "plastic". Explain to students that each different plastic is made of a different chemical material. Lead students to recognize that each type of plastic can therefore only be recycled with plastics of a similar chemical makeup. Discuss the problems of plastics and their disposal. Challenge students to brainstorm alternative/innovative solutions to this dilemma.

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Have students read and discuss the information sheet. Then divide the class into small groups with a variety of plastic bottles (a three bottle per student ratio or greater is recommended). Assign students the task of finding five different ways to group or classify the bottles assigned to their group. Function, color, shape, type of opening are all possible ways – you may need to suggest a few, and have students go through physically regrouping the bottles before they understand the process. Have each group keep notes on the various kinds of groups they have formed, then share them with the class. Combine bottles from all groups and have students determine new classifications.

EXTENSION

Weigh (or try to balance) several containers which hold the same volume, to compare their densities. Fill them with water and compare how they float, if a large sink is available.

VOCABULARY

PET
HDPE
petrochemical
dioxin
polymer

NINETY-TWO POUNDS OF TROUBLE

Plastics have changed our way of life. Each year, items once available in glass or paper appear in new plastic packaging. Is this good news or bad?

The good news is that plastic really does have a lot of advantages. It is flexible and strong. It won't break when you drop the bottle with soapy hands. It can be shaped and colored in many different ways. The cost to manufacture it is fairly low.

What, then, is the bad news? As of 1986, Americans were throwing away 92 pounds of plastic per person each year! That means that the raw materials and the energy needed to make the plastics are wasted. Since plastic is permanent, it will stay in a landfill forever.

What should we do? Here are four possible answers: ban, biodegrade, bury and burn. But banning plastic won't work. We like its convenience. Very few plastics now made will biodegrade. To bury the plastic in a landfill takes up too much space. Some people think that burning plastics in an incinerator is the best idea. Plastics do help all the other types of solid waste to burn better. But, 60 - 90% of the energy used to make plastic is still lost. Also, the air released from burning may be harmful to our health.

As you may have guessed, recycling is the best ending to the life of a plastic bottle. There are many different kinds of plastic in use. Thus, there are some problems. Only plastics whose chemical makeup is the same can be recycled together. Milk bottles are made of a chemical known as HDPE. Soda bottles are formed from another plastic known as PET. The two plastics can't be mixed. Sorting and separating plastics first, and then recycling them makes sense. We can save energy, resources and money. More than $20 billion could be saved each year if we recycled all waste plastics.

Recycled bottles are compacted into bales, shredded into strips, or ground into small flakes. Then they are hauled away to be reformed. Such plastics are now used in fiberfill (for jackets, sleeping bags, and pillows), car seats, straps for movers, wall tile, toys, and scrub pads. Some plastics can be reformed into fiberglass tubs, showers, boat hulls and swimming pools. A new type of "plastic lumber" is now being used in some construction projects.

Using plastics may be a habit that's hard to break. We need to form the recycling habit as well. Then the cost, to our environment and ourselves, will be much less.

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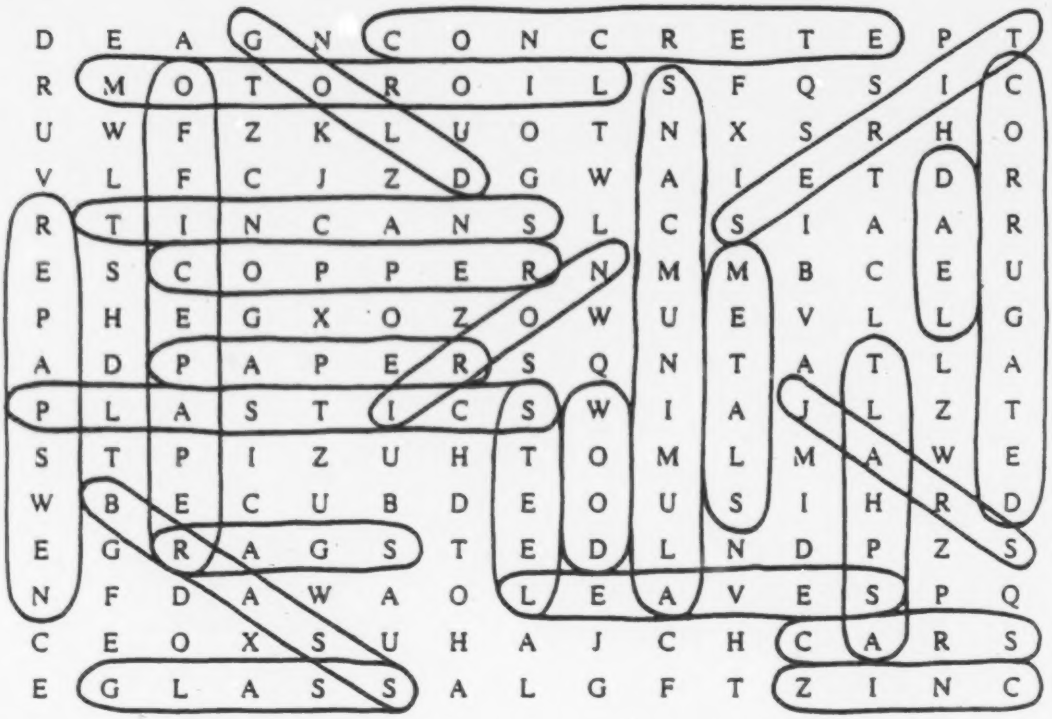
WORD SEARCH – things that can be recycled



D	E	A	G	N	C	O	N	C	R	E	T	E	P	T
R	M	O	T	O	R	O	I	L	S	F	Q	S	I	C
U	W	F	Z	K	L	U	O	T	N	X	S	R	H	O
V	L	F	C	J	Z	D	G	W	A	I	E	T	D	R
R	T	I	N	C	A	N	S	L	C	S	I	A	A	R
E	S	C	O	P	P	E	R	N	M	M	B	C	E	U
P	H	E	G	X	O	Z	O	W	U	E	V	L	L	G
A	D	P	A	P	E	R	S	Q	N	T	A	T	L	A
P	L	A	S	T	I	C	S	W	I	A	J	L	Z	T
S	T	P	I	Z	U	H	T	O	M	L	M	A	W	E
W	B	E	C	U	B	D	E	O	U	S	I	H	R	D
E	G	R	A	G	S	T	E	D	L	N	D	P	Z	S
N	F	D	A	W	A	O	L	E	A	V	E	S	P	Q
C	E	O	X	S	U	H	A	J	C	H	C	A	R	S
E	G	L	A	S	S	A	L	G	F	T	Z	I	N	C

Horizontal: concrete, motor oil, tincans, copper, paper, plastics, rags, leaves, cars, zinc, glass

Vertical: newspaper, officepaper, steel, wood, aluminumcans, metals, asphalt, lead, corrugated

Diagonal: gold, iron, tires, brass, jars

NOTE: YOU MAY WISH TO PROVIDE YOUR STUDENTS WITH A GENERAL LIST OF WORDS FOUND WITHIN THE WORDSEARCH IN ORDER TO MAKE THEIR TASK EASIER.

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WORD SEARCH – things that can be recycled

D	E	A	G	N	C	O	N	C	R	E	T	E	P	T
R	M	O	T	O	R	O	I	L	S	F	Q	S	I	C
U	W	F	Z	K	L	U	O	T	N	X	S	R	H	O
V	L	F	C	J	Z	D	G	W	A	I	E	T	D	R
R	T	I	N	C	A	N	S	L	C	S	I	A	A	R
E	S	C	O	P	P	E	R	N	M	M	B	C	E	U
P	H	E	G	X	O	Z	O	W	U	E	V	L	L	G
A	D	P	A	P	E	R	S	Q	N	T	A	T	L	A
P	L	A	S	T	I	C	S	W	I	A	J	L	Z	T
S	T	P	I	Z	U	H	T	O	M	L	M	A	W	E
W	B	E	C	U	B	D	E	O	U	S	I	H	R	D
E	G	R	A	G	S	T	E	D	L	N	D	P	Z	S
N	F	D	A	W	A	O	L	E	A	V	E	S	P	Q
C	E	O	X	S	U	H	A	J	C	H	C	A	R	S
E	G	L	A	S	S	A	L	G	F	T	Z	I	N	C

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ONCE IS NOT ENOUGH

Art/Reading Activity

Students will be able to explain to their peers the benefits of recycling aluminum cans.

MATERIALS NEEDED

large drawing paper or craft paper, painting materials, string, aluminum beverage cans (one per student), student worksheet, (one per student)

BACKGROUND

To produce one ton of aluminum requires:
- 8,766 pounds of bauxite
- 1,020 pounds of petroleum coke
- 966 pounds of soda ash
- 327 pounds of pitch
- 238 pounds of lime
- 197 million BTUs of energy

Pollutants generated include:
- 3290 pounds of red mud
- 2900 pounds of carbon dioxide
- 81 pounds of air pollutants
- 789 pounds of solid wastes

Recycling of aluminum (rather than new production) can reduce energy use by 95% with similar reductions in water and air pollution.

To produce one ton of steel requires:
- 1970 pounds of iron ore
- 791 pounds of coke
- 454 pounds of lime
- 29 million BTUs of energy

Pollutants produced include:
- 538 pounds of solid wastes
- 242 pounds of air pollutants

Recycling of steel can reduce energy consumption by 74%, with an 86% reduction in air pollutants, 40% reduction in water use, 76% reduction in water pollutants and 97% reduction in mining wastes.

Our metal discards have been referred to as "mines above ground" because the metal found in cans, automobiles, refrigerators, stoves, steel beams, car radiators etc., has already been through the costly extraction process. It has the potential to be remelted or detinned and used over and over again, without further withdrawals from the supply still left in the earth.

TREE AMIGOS

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When 1000 tons of steel are made with scrap, the energy saved is the equivalent of 140,000 gallons of gasoline! It also requires 8,500 fewer kilowatt hours of energy to produce one ton of steel from automobile scrap than to use iron ore. That's enough energy to supply the electrical needs of an American family for almost a year! One-and-one-half tons of iron ore and one-third ton of coal/coke are saved with each ton of scrap metal used.

In spite of these savings, there has not been sufficient economic incentive for metal manufacturers to use recycled steel. An increased, steady supply (from states committed to recycling) and a demonstrated effort by concerned citizens who are no longer willing to waste our precious metals should serve to boost this market considerably.

IMPLEMENTATION

You may wish to have students experiment with and differentiate between cans of different metals, in which case you could share the following information or encourage students to create their own charts through careful observation.

ALUMINUM CANS (soda) – not attracted to magnet; almost all say "All Aluminum" on the side; no seam; bottom is round and somewhat shiny; can is shiny, silver, smooth; lightweight; finely brushed on the bottom; printing is directly on the can rather than on a paper label

BIMETAL (small juice cans, tuna fish cans, tennis ball cans) – not attacted by magnet; bottom has a rim; bottom is not finely brushed; usually spray painted; may or may not have a seam

TINNED (soup cans) – is attacted by magnet; always has a seam; heavier in weight than aluminum; usually has rings or ribbing on the can; normally has a paper label

Explain to students that aluminum cans are easily recycled. The aluminum itself is a valuable commodity and can be reused over and over again. Some can manufacturers have been involved in buying used aluminum for many years because of the savings in raw materials and energy for processing. Some communities (North Kingstown, R.I. is one) have "Can Banks" – reverse vending machines – where a consumer inserts empty cans and receives payment. Civic groups have collected aluminum cans in order to realize the profit (1986 prices – 24 cents per pound with 23 cans per pound). In Rhode Island, cans will be collected with other recyclables for processing and sale.

Distribute student reading sheet. Help students to identify four benefits of recycling aluminum (saving energy, saving natural resources, profit, and less destruction of the earth through mining). Ask if students have previously recycled cans and if, now that they know the benefits, they would be inclined to do so.

Distribute painting materials, two large sheets of drawing paper per student and aluminum beverage cans. Paper should be large enough so that students can wear their completed cans as signs or sandwich boards. Instruct students to study the design and words on the can carefully and to paint them on the paper, the front of the can on one sheet and the back on the other.

When the paint has dried, have students model their cans (with string attaching the papers at the shoulder) and prepare a one minute talk on the benefits of recycling aluminum cans. Help the class to choose the five best "cans" to deliver the recycling message to five other classes.

EXTENSION

Encourage students to begin a can recycling project at school if your city has not yet begun participation in the mandatory recycling program. For assistance, contact OSCAR concerning the "I *CAN* RECYCLE" program. Prepare a storage area in the classroom and contact a local recycling center for redemption. A list of recycling centers is available from OSCAR.

To increase storage capacity, students may create a can crusher by attaching two one-foot lengths of 2 x 4 with a hinge.

Challenge another class in your school to a contest to see which class can accumulate the greatest number of cans for recycling. Plan an activity to share the profits.

VOCABULARY

bimetal
tinned
aluminum
alloy
flux

ONCE IS NOT ENOUGH!

An aluminum can, left outside, will not just disappear. It will take the sun, wind and rain 500 years or more to break it down into dust. Why? Why is aluminum so long-lasting? Its chemical composition protects it. This is helpful as long as the item is being used. But even when we are finished with it, the can lasts for a long time.

Aluminum is made by mining bauxite and mixing it with other alloys. It is useful when a lightweight yet strong material is needed. Many aircraft materials are aluminum. So are beverage cans, pie plates, frozen food trays, and foil. Building materials like siding, gutters, and window frames are also aluminum. They can all be recycled.

Recycling saves the natural resources used to make the end product. It saves energy – 20 recycled cans can be made using the same energy as one new can. It saves the earth, which must be mined to take out the bauxite. And it saves money.

In 1985. Rhode Islanders threw away $2,000,000 in aluminum cans which could have been recycled! Some towns and cities require people to recycle cans. Some civic groups collect them. In each case, the cans are worth money. Can dealers pay by the pound for the cans brought in. It takes about 23 twelve-ounce aluminum cans to make one pound.

Not all cans are aluminum. How can you tell which ones are? They don't have side seams, they won't stick to a magnet, they are lightweight and easy to crush.

When cans are recycled, they follow a circular path. First, magnets remove any steel cans accidentally mixed in. Then the cans are flattened and shredded into pellets or baled. Next, the aluminum goes to a smelting plant where it is melted. Furnaces melt the aluminum with flux for 18 hours to skim off impurities. Then it is poured into molds and cooled. Next it goes to a manufacturer who can hot-roll it into strip aluminum to form more cans. The cans are filled, sold and the contents consumed. Then they can be recycled – again and again.

Nationwide, we now recycle over half of all the aluminum cans we use. Are you doing your part?

"Oscar's Options"
83 Park St
Providence, RI 02903

Litter — It's Everywhere!*

Age: 8-15 years old

Goals: To make people more aware of litter and to encourage them to think of ways to help curb our litter problem.

Background:

Food wastes from snacks, extra packaging, soda cans and paper may all be found in your area. Factors contributing to this problem may include: not enough trash cans, careless campers, the wind blowing trash against a fence, or uncovered trash cans. (For more information, see the background section in Trash Hunt).

Materials:

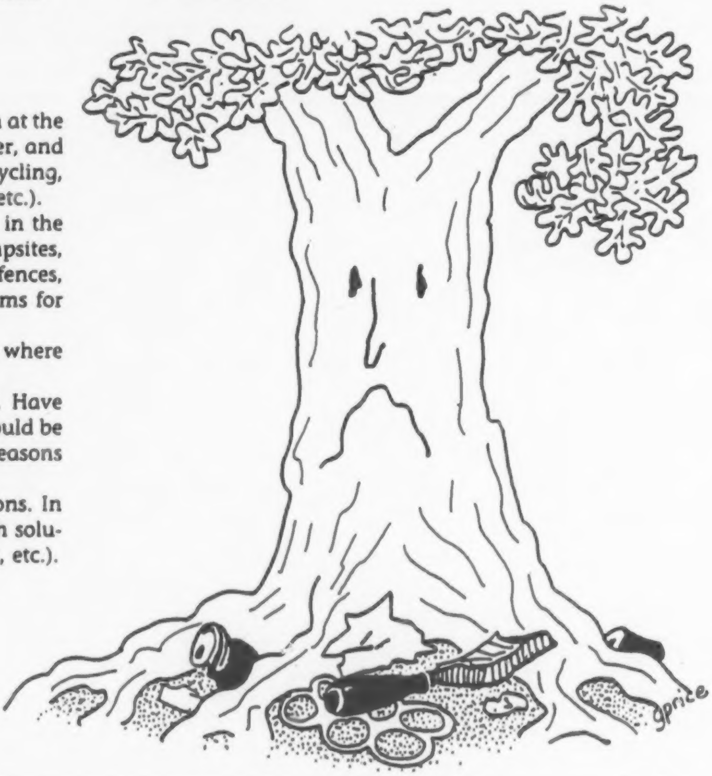
1 map of the nature center area/park per person
clip boards
writing utensils

Procedure:

1. Discuss litter and what a problem it is, both at the park and elsewhere. Talk about why people litter, and what can be done to help reduce litter (recycling, reusing, more conveniently placed trash cans, etc.).
2. Give each person a map. Ask them to fill in the details of the area, (building, parking lots, campsites, trees, play equipment, pop machines, beaches, fences, trash cans, streets etc.) Display a legend of items for them to use.
3. Tell them to circle on their maps the places where they predict that the most litter will be found.
4. Encourage people to explain their ideas. Have them consider what types of litter they think would be found in the yard, and ask for any possible reasons they have to explain this.
5. Go out on a walk to check their predictions. In key littering locations, have them come up with solutions ("No Littering" sign, trash cans, warnings, etc.).

Going Beyond:

- If the group comes up with a great solution, tell them you'll implement it. After a few weeks, (if it's a school group), write to the group to let them know how their solution is working.
- If the group is a school group, suggest that the class re-do this activity for the school grounds. Have them make suggestion to the principal and school board on ways to reduce litter. And, have a member of an environmental group talk to the class about pollution problems and solutions.
- Do the Trash Hunt activity in this booklet, or incorporate the ideas from the activity into the discussion for this activity.
- Sing the songs related to litter from the song section of this booklet.



"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Trash Hunt

Age: 6-12 years old

Goals: To develop an awareness of littering and the problems it can cause, and to clarify the difference between litter and trash, renewable and nonrenewable resources, and recyclable and nonrecyclable items.

Background:

A knowledge of the definitions for the following pairs of words will make the discussion more interesting: litter and trash, recyclables and nonrecyclables, renewable resources and nonrenewable resources, and biodegradable and nonbiodegradable. These can be found in the glossary.

Not only is litter undesirable to look at, but it can also be harmful to wildlife.

- Little fish can swim through the pop-top of a soda can and get stuck.
- Birds, larger fish, and small mammals can be strangled in the loops of plastic six-pack holders.
- Loose fishing line can get wrapped around the legs, wings and beaks of water birds, impairing their movement and strangling them.
- Some wildlife may even mistake shiny litter for food. When pop-tops and bottle caps are eaten they can cause injury. Styrofoam cups, plastic cellophane wrappers and cigarette butts have been found in the stomachs of deer.
- Broken glass, edges of opened cans and empty jars are all dangerous. Animals can get cut, get infections and even die. They also can be trapped in slippery glass jars.

Some people are promoting biodegradable plastics as a partial solution to our litter and landfill problems. These plastics are made with a starch or yeast that binds the plastic polymers together. When they "break down" in the environment, the starches or yeast decompose but the plastic polymers remain.

Biodegradable plastics help our litter problem, but not our landfill problem. When buried in a landfill, they do not break down for a long time because of the lack of oxygen. In addition, starches and yeast may contaminate plastic that could otherwise be recycled.

Materials:

1 trash bag per pair (reuse old shopping bags)
1 pair of gloves per pair

Procedure:

1. Have a discussion with the group about litter. Explain the difference between litter and trash. Ask: How do you feel about litter? Why do people litter? Does nature litter? What happens to nature's litter?
2. Explain that the group's mission is to find litter in the area. It doesn't matter how big or small the pieces are.
3. Distribute bags and gloves to every pair. Set a time limit and boundaries to avoid stragglers. Set them free on their mission.
4. After the hunt, gather the group in an area sheltered from the wind. Have the children dump their litter in a pile in front of the group.
5. Pick through the pile. Find litter that is harmful to wildlife and explain how it's harmful.
6. Define renewable and nonrenewable. Have the children sort through the pile picking out examples of each.
7. Define recyclable versus nonrecyclable. Have the children decide whether the litter pieces should be put in a trash can to go to the landfill, or in a box to be recycled.
8. Define biodegradable and nonbiodegradable. Have the children decide which litter is biodegradable and which is nonbiodegradable. Discuss the pro's and con's of biodegradable plastics.
9. Dispose of the litter properly.

Going Beyond:

- Use some of the items collected during the hunt in the Mini-Composts activity.
- Put the money made from collecting recyclables towards educational materials.
- Sing the litter songs in the Sing Along section of this booklet.
- Create a "trash monster" or trash collage with the collected litter.
- Draw before and after pictures of the cleaned up area. Have the children write stories to go along with their pictures.

"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

WHAT DO I DO WITH THIS?

OBJECTIVE: Students will enhance their awareness of the effects litter has on wildlife.

SUBJECTS: Science, Language Arts

SKILLS: critical thinking, observing, creating, group work, researching, hypothesizing.

MATERIALS: Common sources of litter—plastic bottle, plastic bag, six-pack can holder, styrofoam cup, bottle, etc.

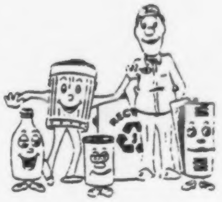
PROCEDURE:

1. Ask the students if they have ever seen or read about the effects litter has on wildlife? List examples.
2. Divide the class into groups, depending on the number of "litter" items available.
   - Distribute one item to each group and have them think of themselves as an animal (chipmunk, squirrel, bird, etc.) having them answer the following questions and recording their results:
     - What would it be like to use this item in their life or could they use it?
     - What harm might it cause them?
     - Does the good outweigh the bad or vice versa?
3. Have the groups switch items and continue the same procedure for the time allotted.
4. Have each group share their information orally for a selected piece of litter.
   - Compare information for each group for similarities/differences.

EXTENSION:

1. What can be done to prevent these things from occurring?
2. Research the effects of litter on types of wildlife.
3. Collect current events relating litter to wildlife.
4. Illustrate the effect litter has on wildlife.

"Here Today, Here Tomorrow-Revisited"
NJDEP, Division of Solid Waste
Management Education Program
CN 414, 401 E State St
Trenton, NJ 08625



"WHEN IT'S WRONG TO BELONG" SCAVENGER HUNT

OBJECTIVES: Students will become aware of the various forms of litter found in different environments. Students will be able to distinguish between man-made litter and natural materials that people dispose of improperly.

SUBJECTS: Science, Social Studies

SKILLS: observing, collecting, analyzing, generalizing.

MATERIALS: paper bags (one per group).

PROCEDURE:

1. Select an area for study and divide students into groups. Tell students they will be participating in a scavenger hunt.
2. Each group receives a list of the items expected to be found in this "unfamiliar" environment and a bag to collect the items.
3. Determine the length of time for this activity and have the students find as many items as possible.
4. Discuss the items found, having the students comment on how they got there.

While this activity can be done almost anywhere, it might be more effective in a "new" environment to the students. It is recommended that the teacher visit these areas first to better prepare the "scavenger" sheet.

EXTENSION: Use this same activity in different environments and compare the result.

Examples might be:

A trip to a beach
a crab's claw
sea glass
driftwood
something metal
something aluminum
a shell

Forest/Woods
an oak leaf
evidence of an animal
evidence of a person

A trip to a city park
something lost by a person
a coin
something glass
evidence of people
aluminum can

Common to all
something blue
something plastic
something bigger than your nose

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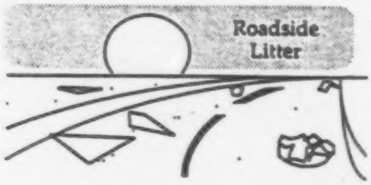
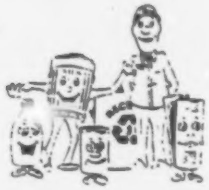
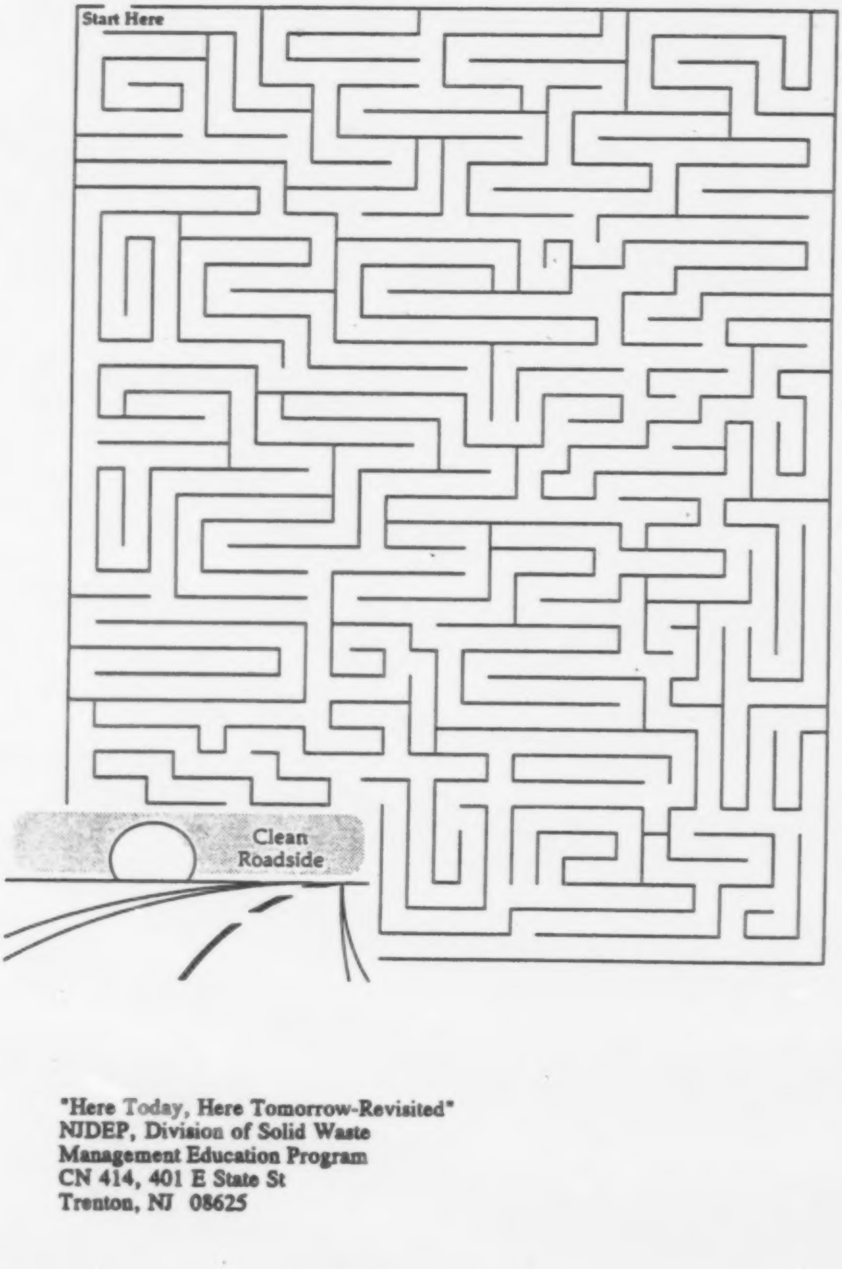
How Do We Get There ?


Roadside
Litter




Start Here
Clean
Roadside

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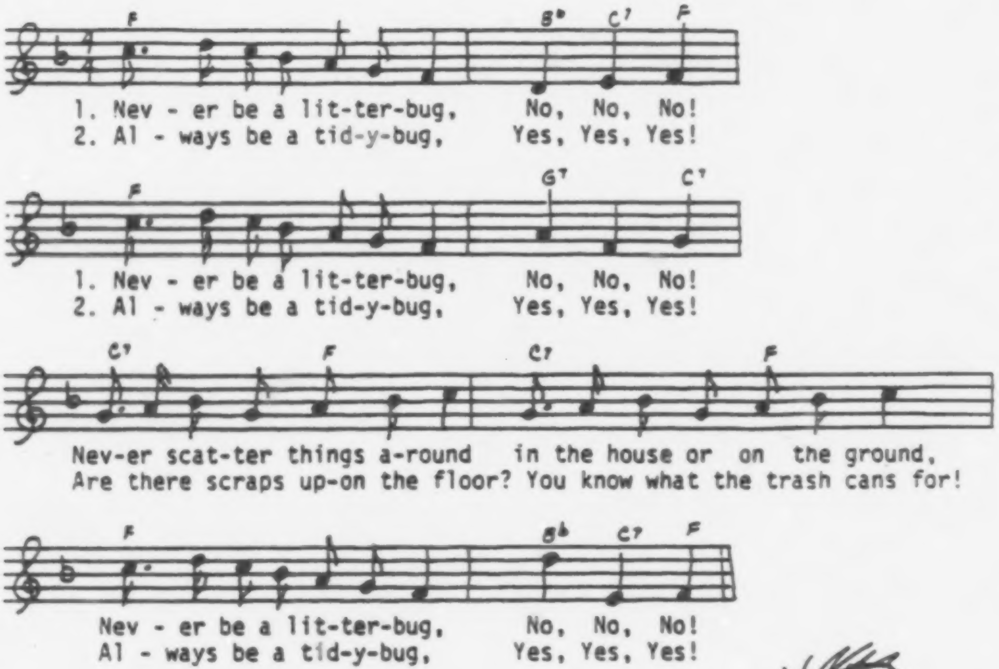
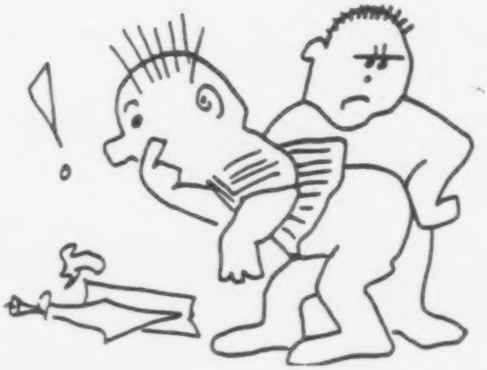
Trenton, NJ 08625

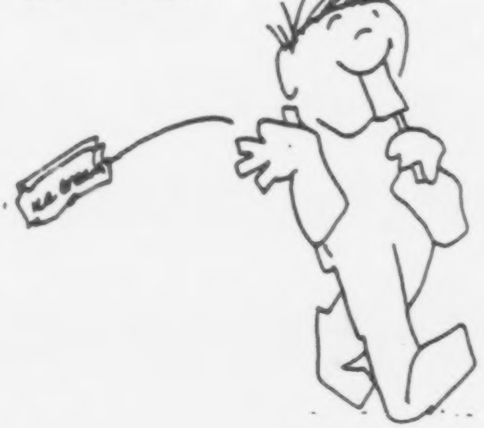
Never Be a Litterbug

Words and music by
Catherine Y. Hoagey

From the Instructor Magazine
April, 1963


F
B♭
C7
F
1. Nev - er be a lit-ter-bug, No, No, No!
2. Al - ways be a tid-y-bug, Yes, Yes, Yes!
F
G7
C7
1. Nev - er be a lit-ter-bug, No, No, No!
2. Al - ways be a tid-y-bug, Yes, Yes, Yes!
C7
F
C7
F
Nev-er scat-ter things a-round in the house or on the ground,
Are there scraps up-on the floor? You know what the trash cans for!
F
B♭
C7
F
Nev - er be a lit-ter-bug, No, No, No!
Al - ways be a tid-y-bug, Yes, Yes, Yes!





"Reduce, Reuse, & Recycle Activities For All Grades"
Waste Education Clearinghouse
Office of Waste Managment
1350 Energy Lane
St. Paul, MN 55108

OH, WHAT A BEAUTIFUL MORNING

Oh, what a beautiful morning,
Oh, what a beautiful day,
The inversion layer has lifted,
I can see clear 'cross the Bay.

There's a brown golden haze over Richmond,
And it's spreading to San Jose.
The smog is so thick, it's making me sick.
Oh, when will the wind come and blow it away?

(Repeat first stanza)

THREE LITTLE STYROFOAM CUPS

Tune: Up on the Housetop

Three little styrofoam cups are we,
Used once at a meeting to hold coffee.
Plastic assures us of immortality.
People think disposing of us is free.

Oh, no, no. That's not so.
Oh, no, no. That's not so.
Three little styrofoam cups are we,
Disposing of us is never free.

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WHERE DOES ALL MY GARBAGE GO?

(Tune: Where Have All the Flowers Gone?)

Where does all my garbage go? I've been asking.
Where does all my garbage go? I want to know.
Where does all my garbage go? Fills the bay, don't you know?
When will we ever learn? When will we ever learn?

Where will all the people go? I've been asking.
Where will all the people go? I want to know.
Where will all the people go? Concrete houses, row on row.
When will we ever learn? When will we ever learn?

Where will all the wildlife go? I've been asking.
Where will all the wildlife go? I want to know.
Where will all the wildlife go? Towards extinction, don't you know.
When will we ever learn? When will we ever learn?

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WHAT IS YOUR LANDFILL I.Q.?

OBJECTIVE: The students will determine people's attitudes toward landfill sites by interviewing community members.

SUBJECTS: Social Studies, Language Arts

SKILLS: interviewing, interpreting data, communicating, analyzing, graphing.

MATERIALS: questionnaire, pen, clipboard.

PROCEDURE:

1. Prepare a list of community members to be interviewed.
   Include representatives from the food, health care, fire and safety, school, park, citizens, business, manufacturing, waste management, and political sectors.
2. Assign students to interview someone from the above list.
3. Conduct the interview using the supplied questionnaire.
4. Compare the information received from different community members—is it the same?
5. Discuss the reasons for the different answers.
6. Discuss:
   a. Are people knowledgeable about landfills? Why or why not?
   b. Do people know about their local landfills? Why or why not?
   c. How can you make people more aware of landfills? Do you think they need to be more aware? Why?
   d. Do you think you could get all of the different people in the community to agree on one landfill site?
7. Graph selected results of questions 8 and 9 on the survey sheet in separate graphs.

EXTENSION:

1. Have the students design a survey questionnaire on a local issue concerning solid waste disposal. Questions should be designed so the results could be graphed. (i.e., yes, no or multiple choice)
2. Take a solid waste issue and have the students hold a debate assigning students to represent different segments of the community and have them role play, assuming the attitudes and values of the person they represent.

"Here Today, Here Tomorrow-Revisited"
NJDEP, Division of Solid Waste
Management Education Program
CN 414, 401 E State St
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LANDFILL QUESTIONNAIRE

1. What 6 words do you associate with a landfill ?

____________ ____________ ____________

____________ ____________ ____________

2. Where is your town's landfill ?

____

3. Who selects landfill sites ?

____

4. How much does it cost you for garbage collection ?

____

5. What would you consider to be an ideal site for your garbage ?

____

6. If it were determined that our town had an evironmentally safe site for a landfill, would you support locating it at that site ?

Yes ____________ No ____________

Why ? ____

7. Do you think landfills have a negative impact on :
(1-strongly agree; 2-agree; 3-disagree; 4-strongly disagree)

Air Quality	_____	Property Values	_____	Aesthetics	_____
Town's Image	_____	Neighborhood	_____	Traffic	_____
Wildlife	_____	Water Quality	_____	Taxes	_____

8. What are the positive aspects ?

____

____

____

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WHEN WILL IT EVER END?

OBJECTIVE: Students will understand that society must provide for landfill sites.

SUBJECTS: Language Arts, Social Studies

SKILLS: critical thinking, reasoning, group work, hypothesizing.

MATERIALS: torn plastic bag, ripped paper bag, ruined piece of clothing, broken record, wornout shoe, etc. (things no longer useful).

PROCEDURE:

1. Divide the students into groups, choosing one person as spokesperson.
2. Give each group an item which can no longer be used as it was intended to be used, and which has no more useful life.
3. Ask each group to speculate for 3 minutes about the past and future of the item.
4. Ask the group's spokesperson to give a summary to the class.
5. Hypothesize about the future of a useless large item.
6. Discuss the idea that landfills will always have to be available even if reuse and recycling is practiced by everyone.

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Where Has All The Garbage Gone?

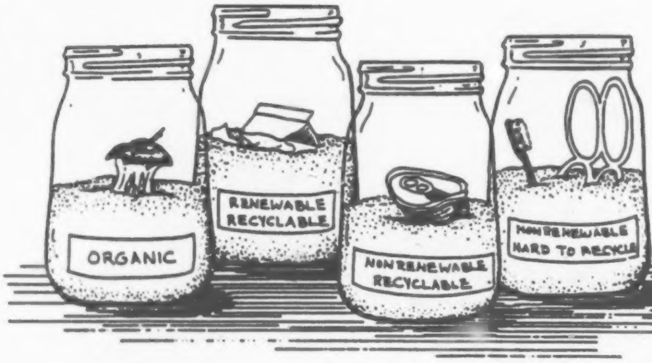
Part 1 — Making a Mini-Landfill *

Goal: To have students examine the materials that comprise the products they use, describe whether these materials are renewable or nonrenewable resources, observe what happens to materials when placed in a landfill and decide whether they should be disposed of in a different way.

Subjects: Science; social studies, environmental education.

Grades: 4-6

Materials:
- four large clear glass jars
- soil
- miscellaneous solid waste
- crayons
- masking tape



Procedure:

A) 1. Choose one item you threw away today. What is your item made of? Into which of the following four categories of solid waste does your item fit?
a) organic (e.g., potato peels)
b) renewable resource/recyclable (e.g., newspaper)
c) nonrenewable resource/recyclable (e.g., aluminum cans)
d) nonrenewable resource/hard to recycle (e.g., plastic toothpaste tube)

2. What happens to the item you threw away? Discuss:
- Where is away?
- What is a landfill?
- How might the material that a piece of trash is made of determine how you should dispose of it?

3. List ways you can avoid disposing of your item in a landfill.

4. If your goal is to save natural resources and reduce solid waste, from which category (a-d) would you buy products? Which category would you avoid?

B) 1. With crayons and masking tape, label each glass jar with one of the four category headings above.

2. Fill each jar about half full with soil.

3. Sort each miscellaneous solid waste item into its proper category (a-d). Put a small sample of each into the jar with the corresponding label. Cover with soil and keep damp with water. Leave the lid off and place the jar on a shelf away from people and out of direct sun. Stir occasionally.

4. Predict what you think will happen to the solid waste in each jar. Record your predictions.

5. Observe and record what changes occur during a 2-3 week period, if any. Discuss:
- What happened to the items made of organic and renewable resources?
- What happened to the items made of nonrenewable resources?
- How did what happened compare with your predictions?
- What comparisons can you make between your mini-landfill and a real landfill?

C) 1. Keep a record of your family's purchases from two trips to the grocery store. Divide the items into the four solid waste categories listed above. Discuss:
- What does your family do with the waste from its store purchases?
- Is there anything else your family could do with this waste?
- Could you substitute items from "d" with items from "a-c?" Is this a worthy goal? Why?
- If your goal is to reduce solid waste, which items would you eliminate from your shopping list?

Pre- and Post-Activity Questions:
- Define and give examples of: organic material, renewable resource, nonrenewable resource.
- What do you think will happen to items made of renewable or nonrenewable resources when they're dumped in a landfill?
- List four items you use everyday that you could recycle.

TREE AMIGOS

Recycling Study Guide
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

Goal: To have students see where their garbage goes and investigate their community's solid waste disposal issues.

Subjects: Social studies, science, health, environmental education.

Grades: 4-12

Procedure:

1. a) Contact your municipal landfill and obtain permission for your class to visit it. Arrange for the site manager, owner or other resource person to guide your trip and be available to answer questions. A list of local waste disposal sites can be obtained by contacting your DNR district solid waste management specialist. (Be sure to follow all safety precautions while visiting the site.)

b) If you're unable to take a field trip, ask a guest speaker to come and discuss local solid waste management with your class. Resource people you might contact are: waste disposal site operators, private waste haulers, Extension agents, environmental health officers, government officials, environmental organization representatives, DNR and local solid waste managers and public works personnel.

2. Before visiting the municipal landfill or having a guest speaker, develop a list of questions you would like answered. Investigate possible answers to your questions. Then send the questions to the guide or guest speaker in advance so they can prepare responses. Questions to consider include:

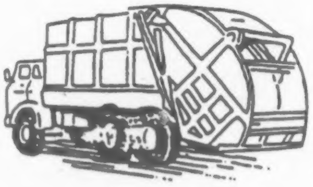
- Where is the garbage from your school or home taken?
- How does it get there?
- Why was the landfill located on this site? What factors must be considered when a site is selected? What tests were done at the site before it was opened? What were the results?
- What laws govern solid waste disposal in your community?
- Is the landfill an engineered or unengineered site?
- Who owns the landfill? When did it open? What was the cost of constructing it?
- Who does the site serve? Who can bring wastes to the landfill?
- What is the fee for using the landfill?
- How much does your family pay for trash collection?
- How much does it cost to take care of trash once it's in the landfill?
- How much solid waste is disposed of at this site daily, weekly and yearly?
- Who works at the site? Do they monitor what is dumped?
- What happens to the trash once it's dumped in the landfill?
- Are any of the materials hazardous? Are there regulations or procedures for dealing with hazardous wastes?
- What is the land adjacent to the landfill used for? Is the landfill a problem for nearby landowners? If so, in what ways?
- How is the site managed for control of blowing trash, odors, noise, animals, erosion, surface runoff and leachate?
- Are tests performed regularly at the site (groundwater, soil, methane gas)? What are the results?
- Is there a resource recovery program at the site? If so, what is recovered? How?
- What impacts does resource recovery have on the economy and environment?
- How many years is the landfill expected to last? How much time does the community have to find a new site?
- How will the landfill be cared for after it is closed? Who is responsible for its care? What will be done with the land at the site?
- What alternatives for waste disposal has your community considered for the future?
- When will these alternatives be carried out?
- How can you participate in making the decisions that develop future waste management plans in your community?

3. Now that you know more about landfills:

- How do you feel about them?
- Are they the best way to dispose of trash? What are possible alternatives?
- What can you do to help reduce solid waste?

Pre- and Post-Activity Questions:

- Where is the trash you throw away taken?
- What eventually happens to your trash there?
- What is the difference between a *dump* and a sanitary landfill?



Going Beyond: For older students...

- If your community has a solid waste incinerator designed for energy recovery, visit it. What are the pros and cons of incineration?
- Investigate waste disposal techniques, problems and laws in other parts of Wisconsin, the U.S. (e.g., New Jersey, California) and the world. Consult individuals, books, newspapers, magazines and state agencies.
- Survey your parents' knowledge and attitudes about solid waste.
- Conduct a hearing to decide where to locate a landfill in your community. Take on the roles of people involved in the decision: local landowners, politicians, industry representatives, environmentalists, waste managers and others.
- Landfills often have been developed in wetlands, although this is now illegal in Wisconsin. Consider the following questions:
  - Why were landfills often located in wetlands?
  - What problems might exist with placing landfills in wetlands?
  - Are wetlands an important ecosystem? Why?

"Recycling Study Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
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Madison, WI 53707

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Composting: A Great, Rotten Idea

Part 1 — Is It Rotten?

Background: When we mention "recycling," we often think of recycling glass bottles, aluminum cans and newspapers. But another 30% of the household garbage we throw out also can be recycled. These recyclables are food scraps, leaves, grass clippings and other *biodegradable* organic wastes. Organic wastes can be recycled by composting. Simply stated, composting creates optimal conditions for decomposition to occur. Decomposition is the biochemical process by which bacteria, fungi and other microscopic organisms break organic "wastes" into nutrients that can be used by plants and animals. Decomposition occurs in nature whenever a leaf falls to the ground or an animal dies. It is essential for the continuation of life on earth. The result of decomposition in a compost pile is a nutrient-rich humus that is excellent for improving soil quality and plant growth.

Goal: To have students investigate the pros and cons of composting.

Subjects: Science, health, environmental education, vocational agriculture, home economics.

Grades: 4-12

Materials:
- rotting log, grass clippings, leaves or food scraps

Procedure:

1. Define: recyclable, biodegradable. List items that are recyclable and/or biodegradable. Discuss:
- Are there recyclable materials that aren't biodegradable? Are there biodegradable materials that aren't recyclable?

2. Feel, smell and look at the rotting log, grass clippings, leaves or food scraps. What words would you use to describe these materials? List these words. Do the words have positive and/or negative connotations? Why?

3. Explain what is happening to the rotting material. Discuss:
- What is the natural process that breaks biodegradable material into particles that can be used again by plants and animals? (decomposition)
- What organisms assist in this decomposition process? (fungi, bacteria, earthworms, springtails, mites, etc.)
- What will your rotting material finally become? (humus)

4. Imagine a world where decomposition doesn't take place. Discuss:
- What would happen to organic materials like dead animals, leaves or sewage?
- Could plants and animals survive if decomposition doesn't occur? Why or why not?
- Is decomposition important? Why?

5. Now think of words to describe rot or decomposition. List them. Do the words have positive and/or negative connotations? Why?

6. List items you throw away that are biodegradable. Discuss:
- How might you and your family recycle these materials?
- What is composting?
- Why do you think people compost household organic wastes?

7. What are some benefits of composting household food and yard wastes? For example:
- Doesn't require the purchase of expensive plastic bags often used for disposing of household and yard wastes.
- Saves the cost of transporting wastes to and handling wastes at the landfill. Wisconsin discards 2.4 million tons of compostable waste every year. It costs $50 per ton to collect wastes in urban areas and $15-$25 per ton to dispose of them. How much money do Wisconsin citizens spend each year disposing of their compostable wastes?
- Saves space in the landfill. Wisconsin's landfills are filling up fast. Within 10 years, most will be filled to capacity. Thus, Wisconsin already has a serious problem — where will we put all our waste?
- Reduces pollution from landfills.
- Creates nutrient-rich humus you can use to fertilize and improve the texture of your yard and garden soil; saves money you might spend on mulch or fertilizer.

8. What are some possible problems with composting? What suggestions do you have for solving the problems? For example:
- It's too much work. Mowing the lawn and washing the car are work, too, but we choose to do these activities because they're satisfying — so is composting! And composting has a positive impact on the environment, which can make us feel good.
- You'd have to run outside everytime you eat an apple or peel a potato. Just place scraps into a plastic container with a lid. Keep the container in or under the kitchen sink, then take the waste to the compost pile whenever the container is full.

TREE AMIGOS

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- It's easier to use the trashbag or garbage disposal. Once you make it into a routine, composting is easy, too. It can make you feel good about doing something positive for the environment by using instead of wasting the fertilizing potential of your garbage. Also, landfilled yard wastes and food scraps take up space and may release harmful methane gas. Food waste put down the garbage disposal ends up in the sewage system, where treating it can tax the system and costs money. If you can afford a garbage disposal, perhaps you can afford a "no work" composter. Easy-to-use, compact and attractive composting bins are available commercially. Contact your garden center or the DNR Bureau of Solid Waste Management for details.
- It might smell and attract rats. If you maintain your compost pile according to basic guidelines in publications like **Home Composting: Reap a Heap of Benefits** (see Resources), your pile shouldn't smell or attract rats.
- The neighbors might not like it. If you locate, build and maintain your pile properly, it shouldn't be offensive. Take the opportunity to explain what you're doing to your neighbors and why you feel composting is important.

9. How would/do you compost your household wastes? Where can you find information to help you? Write or call for information.

Part 2 — Readin', Rottin' and 'Rithmetic: Classroom Composting

Goal: To have students learn about recycling in nature and actually recycle organic matter by composting.

Subjects: Science, health, environmental education, mathematics, home economics, vocational agriculture.

Grades: 4-12

Materials:
- fish aquarium
- organic waste materials (be sure to add a variety of materials, not all one kind, i.e., use sawdust, hair, wood ash and leaves in addition to food scraps; avoid meat scraps, fats and oils, which inhibit decomposition and in outdoor compost piles can attract dogs, rats, raccoons and other animals)
- lawn fertilizer that contains nitrogen (but not herbicides or insecticides); manure and green grass clippings also contain large amounts of nitrogen. A ratio of 25-30 parts carbon to 1 part nitrogen is ideal.
- soil
- 1-2 dozen red earthworms (obtain from yard, garden, school grounds or local bait shop)
- thermometer
- trowel or large kitchen spoon (for turning, or aerating, the pile)

(Note: Air circulation is important to decomposition, thus the best compost bin is one with wire or screen sides. Mass also is important, since approximately one cubic yard of compost is needed to generate good decomposition temperatures (104-170°F). Thus, an aquarium, with its small size and glass sides, isn't the best compost container. Consider constructing an outdoor compost pile with wire sides on the school grounds. Composting instructions are available from: DNR Bur. of Information and Education.)

Procedure:

1. What "ingredients" do you think are needed to construct a compost pile? Why? List ingredients. For example:

- **soil:** contains microorganisms that help decomposition.
- **organic wastes:** such as leaves, food scraps and grass clippings. Wastes should be varied, including materials with both carbon and nitrogen. By alternating layers of high-carbon and high-nitrogen materials, you can create good environmental conditions for decomposition to occur.
- **nitrogen:** many of the organisms responsible for decomposition need nitrogen, thus nitrogen is necessary for rapid and thorough decomposition. Nitrogen is found naturally in many organic wastes, and in many commercial fertilizers.
- **worms:** they eat the waste, helping to break it down; make droppings, which enrich the soil; tunnel through and aerate the waste, facilitating decomposition; and eventually die and become part of the compost.
- **water:** necessary for normal functioning of life. Too much water in a compost pile may make it soggy and slow decomposition by reducing needed oxygen.

- **air:** the biological activity of fungi, bacteria, small insects and other organisms results in decomposition. Most biological processes require adequate amounts of oxygen.
- **time:** decomposition takes time. To speed up decomposition, aerate your pile every few days; otherwise, just leave it and wait.
- **heat:** heat is produced by chemical reactions resulting from increased

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biological activity that occurs during decomposition. Heat helps sanitize compost by killing certain organisms (e.g., weed seeds, pathogens, harmful insect larvae).

- **mass:** in order to generate enough heat for optimal decomposition, the pile must contain at least one cubic meter of organic material. Thus, the temperatures generated in an aquarium compost pile may be different from those generated in one that is larger.

2. Design a plan for making a mini-compost pile in the classroom. Decide which ingredients students will provide and which will be supplied by the teacher. Set a date for constructing your pile.

3. Suggestions for creating a mini-compost pile:
a) Chop the organic wastes into small pieces. You can leave some large pieces of the same materials to compare rates of decomposition between large and small items. Why might there be a difference?
b) Alternate layers of the materials as follows (amounts are approximate): inch of soil, two inches of organic waste, sprinkle of fertilizer, sprinkle of water, repeat.
c) Cover with an inch of soil. Water the pile enough to make it moist but not soggy. It should feel like a damp sponge (it feels moist, but you can't squeeze water out of it).
d) Add the earthworms and observe their behavior.
e) Place your compost pile where it will be at room temperature (not in direct sun).

4. Place the thermometer in the middle of the pile. Wait an hour or so, then record the temperature.

5. Record the temperature from the same location and depth, and at the same time each day. Why is it a good idea to be consistent with location, depth and time of recording? Does the temperature change? Why or why not? Make a graph to show your temperature results.

6. Gently mix the compost once a week to aerate it. A good time to turn the compost is after the temperature peaks and begins to drop. Why? Be sure to record the temperature before you turn the compost that day.

7. Be patient. Occasionally check the moisture and add water if needed.

8. Make a chart to help you keep a daily record of temperature and other observations during the next month or two. Observe:
- Which materials break down the fastest? Slowest? Why?
- Are there any odors? Why do you think decomposition has an odor?
- Does the texture of the compost change? In what ways?

9. Once the materials in your compost pile have decomposed into humus, conduct the same feel, smell and look test that you did in Part 1, #2.

10. Now decide what your class should do with this rich soil. When you clean out the aquarium, should you: dump the humus in the trash; take it outside and dig it into the soil; use it for growing plants in the classroom?

11. Discuss:
- How does composting reduce the amount of waste you would have thrown out?
- What do you think happens to organic wastes that end up in the landfill?
- Is the landfill a gigantic natural compost pile, or are there problems with placing large amounts of organic material in landfills?

12. Now that you have constructed and maintained a mini-compost pile in the classroom, how would you go about constructing and maintaining one at home?

Pre- and Post-Instruction Questions:

- What is composting?
- What are the necessary "ingredients" for a good compost pile?
- How is composting related to the concept of recycling?
- How can composting reduce waste?

Going Beyond:

- Create a compost pile as in Part 2, but also add manufactured items like a soda can, paper clip, bottle cap, aluminum foil, iron nail, pencil, crayon, paper, plastic bag, rubber band, etc. Predict rates of decomposition or lack of decomposition and observe actual changes, if any.
- Take a field trip to a local woods or park. Examine a rotting log or leaf litter. Place a sample of rotting humus in a white enamel pan and sort through it carefully, looking closely for "decomposers." What decomposers (insects, mites, fungi, etc.) can you find? What do you think they're doing? Read about their life histories. (Do activity: A Rottin' Place to Live, in booklet Trees are Terrific. See Resources.)
- Make a Berlese funnel to help you capture tiny soil animals. Examine them using a magnifying glass or binocular microscope. Make drawings of them and try to figure out what kind of animal they are. Read about their life histories. (See: Soil Animals, Living Earth and The Natural History Guide, in Resources.)
- Visit someone who maintains a compost pile. Why do they compost? What do they do with the compost? Have they had any problems? Would they recommend composting?
- Investigate what happens to the leaves your community discards each autumn. What do you think should be done with them?
- If your community has a municipal composting center, take a field trip to it. Be sure to prepare questions to ask the guide.
- Have students design experimental compost piles. For example, make a pile that: is low in nitrogen; lacks moisture; has little air circulation; or is made of a single ingredient (e.g., just grass clippings). Also create a good compost pile for comparison. Compare rates and temperatures of decomposition between piles.
- Fill flower pots with different soil types, including one type that has your humus mixed in. Plant seeds or grow seedlings in the pots. Make 4-5 pots with each soil type so that you're comparing more than one plant grown in each type (i.e., so that you have a large enough sample size to make a valid judgement). Do the plants in different soil types grow at different rates, with different vigor, color, etc? What are possible explanations for any differences?

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BUILDING A BIN

Outdoor Science Activity

Students will construct an outdoor composting container and observe what happens to organic wastes.

MATERIALS NEEDED

Site where organic debris can be piled (a small length of chicken wire, a wooden box or garbage can may be used), shovel or pitchfork, organic debris suitable for composting, student reading sheet (one per student)

BACKGROUND

The compost pile is really a teeming microbial farm. Bacteria start the process of decaying organic matter. They are the first to break down plant tissue and also the most numerous and effective composters. Fungi and protozoans soon join the bacteria and somewhat later in the cycle, centipedes, millipedes, beetles and earthworms do their part.

Anything growing in your yard, as well as most table scraps, is potential food for these tiny decomposers. Carbon and nitrogen from the cells of dead plants and dead microbes fuel their activity. The microorganisms use the carbon in leaves or wood wastes as an energy source. Nitrogen provides the microbes with the raw element of protein to build their bodies.

The more surface area the microorganisms have to work on, the faster the materials will decompose. It's like a block of ice in the sun – slow to melt when it's large, but melting very fast when broken down into smaller pieces. Yard and table wastes need to be fairly small (1" pieces) in order to decompose easily.

The microbes in the compost, like most life on Earth, need a certain amount of air and water. They function best when the compost materials are about as moist as a wrung out sponge, and are provided with many air passages.

IMPLEMENTATION

Choose an out of the way site for your compost pile. The materials may be placed in a heap, a pit, a barrel, wooden box, or chicken wire enclosure. If you use a container, be sure to make openings in the sides and bottom for proper aeration. An enclosure or bin can also be constructed to contain the composting materials (Fig. l). If a bin is used, no floor is needed and one side is left open for easy access.

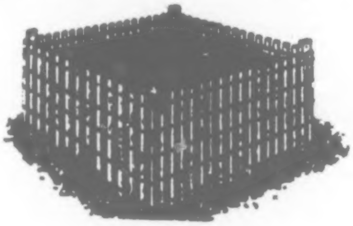

Figure 1

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Any of the following materials can be composted:

- kitchen waste (food scraps, coffee grounds, eggshells etc.)
- yard wastes (leaves, twigs, grass clippings)
- straw
- sawdust
- manure
- newspaper (in 1" pieces)
- ashes
- hay

The decomposition process will be accelerated if these items are chopped or shredded before adding them to the compost pile. Chopping and shredding increases the surface area and provides more space for decomposers to feed and grow. Materials may be added whenever they become available, however, do not add any one substance too thickly. Another method is to arrange the materials in layers (see Fig. 2). In either case the pile must be turned and mixed with a shovel periodically (about once a week) so that the decomposition is complete. Oxygen destroys disease-producing bacteria and keeps the environment odor-free. Decomposer organisms require moist, not soggy conditions. Too much water would keep air from getting to the waste materials, slowing the rate of decomposition. Materials can be sprinkled with water when added to the pile. Add water whenever the pile appears too dry, about every two weeks.

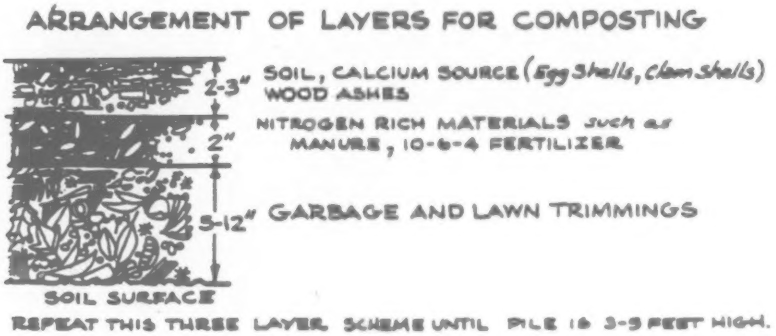
Your compost is ready to use when the material appears finely divided, crumbly, and darker in color. Use it as mulch around trees or shrubs in your schoolyard, applying it several times a year. Mix it thoroughly with soil for gardens or potted plants.

By returning the compost to the soil, you are truly part of the ecological community. Waste materials are reused and organic matter and nutrients are recycled. You are also doing your part to help solve the solid waste problem in your community.

VOCABULARY

composting
compost
decompose
organic

Figure 2


ARRANGEMENT OF LAYERS FOR COMPOSTING
2-3"
SOIL, CALCIUM SOURCE (Egg Shells, Clam Shells) WOOD ASHES
2"
NITROGEN RICH MATERIALS such as MANURE, 10-6-4 FERTILIZER
5-12"
GARBAGE AND LAWN TRIMMINGS
SOIL SURFACE
REPEAT THIS THREE LAYER SCHEME UNTIL PILE IS 3-5 FEET HIGH.

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THE HEAT IS ON

Math and Science Activity

Students will study the heat generation which occurs in composting.

MATERIALS NEEDED

2 buckets, soil, water, organic materials, thermometer, student worksheet (one per student)

IMPLEMENTATION

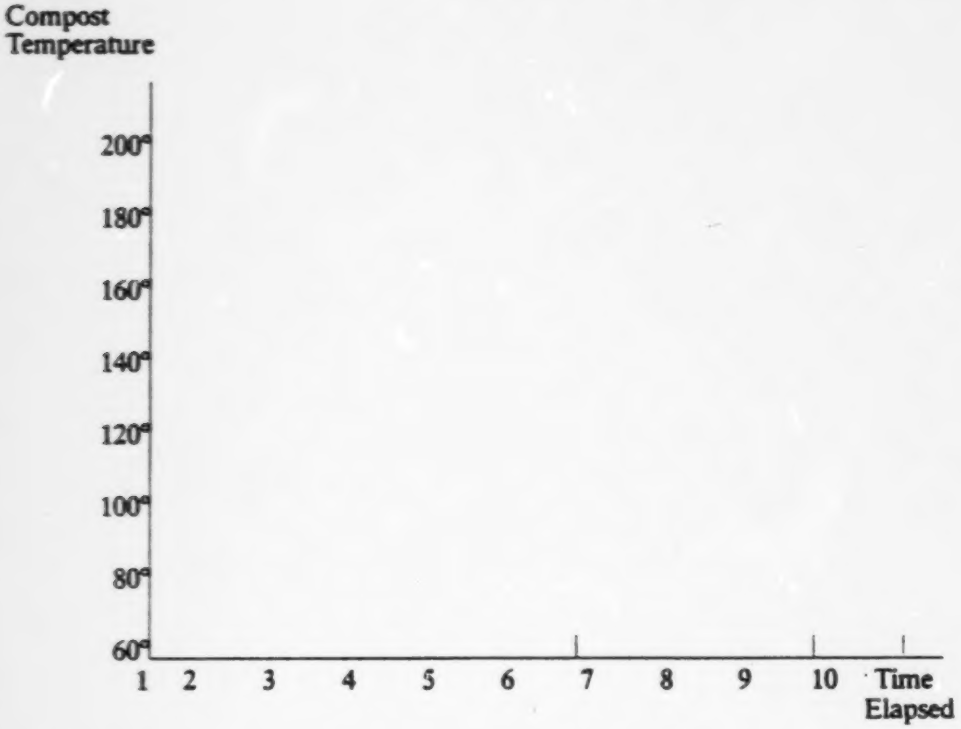
Form a compost mixture in a bucket by adding alternating layers of organic material and soil. The organic layers should be about 3" deep and the soil layers should be about 1" deep. Use any available organic matter – such as food scraps, dry leaves and bits of paper. Keep the compost mixture moist but not waterlogged. (Excessive water will block aeration, creating anaerobic decomposition, which in turn leads to undesirable odors.) To provide aeration, the mixture should be turned every four or five days by transferring the mixture to another bucket.

Each day, insert a thermometer into the center of the compost pile and record the temperature. Mark the temperatures on a graph, with the temperature plotted against time in calendar days. This may be done on an individual basis, or as a whole class activity. (Note: after three weeks, it may be more convenient to record your results as temperature plotted against time in weeks.)

SOURCE

Teaching Resource Recovery in the Classroom

NAME________________________________



Think about it: Why does the temperature start at 60°, not 0°?

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The Fourth "R"

An Action Booklet for Recycling in the Classroom and School

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"As teachers, we meet the future every time we open the classroom door. We share the accumulated knowledge and experience of our generation with our students, offering them lessons in how to better manage the world they will inherit. But advice isn't the only thing we'll be passing along to future generations; they'll also inherit an unavoidable legacy — garbage!" [1]

Let's face it. We have a garbage crisis. The problem is not new. Throughout history garbage has been a dilemma, and with our recent change to a throw-away society, the dilemma has grown into a crisis. Recycling resources, reducing consumption and reusing materials are some solutions to this problem. However, these solutions will require fundamental changes in institutional policies and individual behaviors.

Educators and educational institutions are frequently called upon to address issues when behavioral changes are needed. The garbage crisis is no exception. We are at a point in time which educators refer to as a "teachable moment". Garbage and recycling are on everyone's mind. Teachers are being asked to address this issue by community leaders, and students are asking their teachers questions about it.

Now is the time to add a Fourth "R" — recycling — to the traditional three "R's" of reading, 'riting and 'rithmatic. Fortunately, Wisconsin already has the **Recycling Study Guide** and other educational materials for teachers to use. Many teachers are already teaching recycling in the classroom. But will just teaching about recycling really initiate the attitudinal and behavioral changes required to solve the garbage crisis? Probably not. We must practice what we teach; we must practice recycling, reducing and reusing to reinforce positive behaviors for dealing with our wastes.

This booklet is designed to do just that. Department of Public Instruction curriculum consultants and teachers from all over Wisconsin have contributed their ideas to help you practice recycling, reducing and reusing in the classroom and throughout the school system. Use this booklet as a guide to help your class and school get involved with an issue where they can have an impact.

" As a nation and as citizens of the world, we need to generate less trash by choosing our disposable items wisely and by carefully considering how they will eventually have an impact on our world. We need to create not only an interest in, but a strong social pressure toward recycling." [1]

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I. Daily Practices in the Classroom

All Grades/Classes:

- Separate classroom trash into paper vs. non-recyclables.
- Keep a scrap box for various papers (one-sided, construction, small scraps, etc.)
- Use both sides of paper for reports, homework assignments, drawings, note-taking, work sheets, etc. Create a class motto, such as "Be Nice, Use It Twice!"
- Make note pads from used paper.
- Use white or (even better) unbleached paper when possible. Some dyes are contaminants and cannot be used in producing high quality recycled paper (check with your paper recycler).
- Require separate or special notebooks only when absolutely nec[illegible]y.
- Require use of loose leaf notebooks instead of spiral notebooks. The binders are reusable and the paper is easily recycled.
- At the end of the year, stack notebooks for recycling. Remove spiral bindings and cardboard. *or*, if much of the notebook is unused, encourage students to flip the notebook over, making the back cardboard the front cover, and use it again.
- Use paper towels conservatively.
- Reuse bulletin board paper for more than one month or one season.
- Reduce use of work sheets or put plastic sleeves over work sheets. Have students write with crayon and erase with carpet squares. Plastic sleeves are available from Dorfman Products in California.
- Maximize use of overhead projector and blackboard to minimize use of dittoed directions and information in the classroom.
- Keep a swap box for records, games, tapes, puzzles, toys, books, and magazines in the classroom. Students who bring items from home to be reused can place their names on a sheet and list what they bring (IN) and take (OUT).
- Use cooperative learning and manipulatives (hands-on activities) when possible. These save on paper and offer other benefits.
- Obtain masonite boards, roughly 12" x 18" or 8" x 12", depending on the size of the kids' handwriting. Paint these with two coats of chalkboard paint, "cured" by rubbing chalk across the board, and washed with a wet cloth. (Recycled, of course.) The rule-of-thumb on chalkboard paint is one pint per classroom. Students can use chalk to do their work and when the signal is given each of them can hold the board up in the air so that the teacher can see each student's work. Eraser? Old socks or small carpet scraps. Ask students to figure out a way to estimate the amount of paper saved (reduced) by using the boards for a specified period of time.
- Use "wipe clean" cards or "magic slates" when figuring math problems or practicing writing.
- When giving multiple choice tests, use Scantron Testing Sheets, as they are 1/4 the size of regular paper and are machine scored.
- Use the computer for drill and practice.
- Encourage use of pencils and crayons rather than throw-away plastic pens and markers.
- With older students, encourage use of refillable pens and mechanical pencils rather than throw-aways.
- Use tape and staples sparingly.
- When changing classroom aquarium water, use the aquarium water to water classroom plants.
- Turn off the lights when the classroom is not being used.
- Use items collected from home (food containers, etc.) for storage.
- Take care of books, computer diskettes, and other school materials so they last.
- Put a table in the hallway at the end of the year for students to put unwanted pencils, notebooks, etc. on. Bring the box of materials out at the beginning of next year for students to take and use these items.
- If school policy allows, have each student keep a reusable plastic or porcelain cup in the classroom for beverage breaks, treats, and parties. Younger students can decorate plastic cups with paint pens.
- Have students and staff place recyclable waste in regular waste baskets and place non-recyclables in centrally located trash barrels.

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- Have students bring in the fronts of used holiday cards and place them in a box. Throughout the year have students cut them to regulation post card size. (3 1/2" x 5" to 4" x 6") Have them draw a line to divide the card so that one side can be used for the address and the other for the message. These cards are used for special class projects or by individuals to write thank you notes or notes to friends. Ask students to bring in a stamp and mail the cards from school.
- On field trips:
  - → bring soda cans back to school for recycling.
  - → bring work sheets on homemade clipboards and tie pencils to the clipboards.
  - → encourage students to use lunch boxes and reusable containers.
  - → bring a box for unwanted apples and oranges; make these available for snacks later on.
  - → bring a bag for picking up litter.

Art :

- Ask local industries, galleries, and print shops to donate materials they intend to discard that would be useful in your class (latex paint, paper, plastic containers, etc.)
- Use fabric scraps to wash art room tables. Let tables air dry when possible.
- Keep a box of construction paper leftovers for students to use when they need small pieces for a project.
- Use items collected from home (food containers, packaging etc.) for paint pans or clay sorting.
- Use pictures from magazines for art projects.
- Use scrap paper, cloth, and wood from other classes.
- Attempt to reduce the "supplies" budget for art classes for one year as an experimental alternative to expensive commercial traditions. Contact Fred Maves, Edgerton Community Schools, 200 Elm High Drive, Edgerton, WI 53534 for suggestions.
- Do not throw away broken crayons — use them!
- Make projects out of natural or recycled materials when possible.

Family & Consumer Education:

- Utilize manufacturing simulations to minimize the need to purchase various supplies.
- Prepare small samplings of food products during labs to discourage wasting of foods.
- Make garments, toys, or games from recycled or reused materials.
- Alter and mend garments (saves on buying new garments). Change clothing to a new "style" by adding a scarf or other accessary.
- Keep swap boxes for used or unwanted patterns, buttons, material, notions, etc.

Technological Education:

- Save wood shop scraps for firewood (kindling) or art projects.
- Avoid using treated lumber. It contains poisonous chemicals— the sawdust is toxic.
- Sawdust recycling: See **Wisconsin Technological Education Manufacturing Activity Guide**.
- Collect and repair old tools.
- Cooperate with local industries to supply you with parts, tools, supplies and waste wood they might discard but would be of use to your class.
- Use home collections of left-over latex house paints for projects.
- Use household containers in your activities (example: model rocket).
- Recycle used motor oil (look for used oil receptacles in your community).

Science:

- Make aquariums, terrariums, planters, scientific apparatus and tools from plastic bottles, jugs, utensils and other recyclables (Bottle Biology, B-37 Russell Laboratories, 1630 Linden Dr., U-W Madison, Madison, WI 53706).
- Design "mini-labs" using reduced quantities of chemicals and other supplies.

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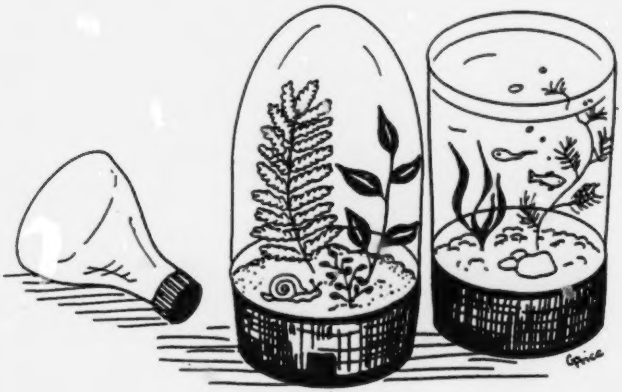
Creative Reusing:

Here are some suggestions for re-using various materials in your classroom:

Use ...	For ...
attendance sheets	scratch paper
baby food jar	beakers, storage
carpenter shavings	classroom animal bedding
cereal box	poster backing
checkbook box	pencil/crayon box
coat hanger	mobiles
construction paper scraps	book marks
deodorant roll-on	tracing numbers, writing practice
egg carton	seed collections
film canister	paste jars, bug collections, soil samples
frozen juice container	paint or water when painting
magazine pictures	creative writing illustrations, art projects, report covers
metal can	pencil holders
milk cartons - plastic or paper	bird feeders
old tire	playground apparatus, flower/vegetable planters
one or two liter clear plastic bottles	mini-terrariums, compost bins, aquariums
paper grocery bag	text book cover, newspaper bundler (no strings!)
paper towel rolls	sending home papers with younger students
permanent wave bottles	glue bottles
plastic laundry detergent bottles	containers of pencils, crayons, etc.
plastic lids	petri dishes, observation trays
plastic milk jugs	banks, art projects, hold water for activities
plastic peanut butter, cottage cheese, yogurt containers	test tube holders
polystyrene packaging (cups, burger containers, etc.)	art projects
small milk carton	paper weight or planter
toilet tissue cores	bird feeders (roll in Peanut butter and seed)



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II. Reduce, Reuse, and Recycle Throughout the School

General/Office/Administration:

- Make small pads of paper from scrap memos and dittos. Distribute to all teachers.
- Use "stickum" slips at a minimum, recycle used paper for notes.
- Reuse or recycle computer paper.
- Have rubber stamp made for hall passes and make passes on used paper.
- Maximize sharing of periodical print material within building to minimize the number of copies needed. Make students aware of the effort.
- Use recycled paper in your school and for school stationery. Successful recycling requires a market for products made from recycled materials — so schools should both supply *and demand* recycled products. See Resources for sources of bulk recycled paper.
- Use both sides of paper for all correspondence.
- Jot down main ideas of articles for teachers rather that duplicating entire articles. Keep articles on file for teachers who would like to read them.
- Write labs, tests, assignments, correspondence etc. on the computer and store on disks. Editing can be done without wasting paper.
- Assign school clubs or classrooms with recycling responsibilities (setting up bins, collecting and transporting materials, sorting, etc.)
- When installing updated copy machines in the office, invest in a two-sided copier. A duplex copier costs $1500-2000 more than a single-sided copier, but savings in paper and filing space will make it cost-effective. Post clear instructions next to copier to make the process user-friendly.
- To save on office paper:
  - → write messages to teachers on partial pieces of paper.
  - → use routing slips to circulate memos
  - → post memos on a central bulletin board
  - → use the P.A. system for all morning announcements
- Order supplies in bulk to reduce packaging.
- Ask to be removed from junk mailing lists, obtain a form at the local post office to remove names of employees from third-class mailing lists, from which most junk mail comes. Or you can write to Direct Marketing Associates, 6 East 43rd St., New York, NY 10017.
- Use white paper or (better still) unbleached paper instead of colored. White paper may be a higher grade than colored ledger on the recycling market and may sell for many times the price. Unbleached paper may not be as valuable for recycling, but it is better for the environment (less pollution in production).
- Keep a box in the office for scrap paper for use in writing memos, teacher messages, announcements, etc.
- Maintain central files instead of filing everything in multiple files.
- Put the school on a mailing list of an environmental periodical so you will receive current information about recycling. See Resources.
- Post current prices for recyclable materials on a bulletin board.
- Put news and achievements regarding recycling in your school in the daily announcements.

Library:

- Reuse paperback books and magazines. Place a shelf in the room where students place books they bring in and exchange them for others. Students who bring books in and who do not find a trade can place their names on a sheet or take a token for later exchange. Make sure the students' names are in their books so they will be returned to the proper owner.
- Sell or give away old books. Perhaps donate them to local charitable organizations, libraries, or organizations doing educational work in foreign countries.
- Save old films and filmstrips for art and other creative projects.
- Save magazines for art and current events projects.
- Recycle newspapers.

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Teachers' Lounge:

- Collect coffee grounds for composting.
- Share magazines with others.
- Put boxes and bins in the teachers' lounge for collecting recyclables.
- Set up a rack for teachers to hang their mugs or cups.
- Do away with disposable cups — have extra mugs available for visitors.

Cafeteria and Food Service:

- Set up recycling bins in the cafeteria. Designate bins for aluminum, uneaten fruit, other food waste, and other specified recyclables. Use uneaten fruit for snacks, empty contents of the unwanted fruit bin into the school's compost pile several times a week *or* give to a local farmer or garden club.
- Distribute milk from a dispenser rather than in separate milk cartons, use washable glasses.
- Use straws only when necessary.
- Use washable, reusable trays, plates, bowls, glasses and utensils rather than disposables.
- Recycle cans and bottles from the kitchen.
- Separate out compostable materials such as clean vegetable and fruit scraps and coffee and tea grounds. Add these to yard materials; have students or grounds personnel compost and use these materials as fertilizer for the school gardens, lawn, and indoor plants.
- Reuse bulk containers for storage. Share extras with teachers and/or community groups.
- Encourage students to:
  - → bring their non-perishable lunch leftovers home so the food will be eaten rather than thrown away.
  - → eat healthy foods which have minimal packaging.
  - → use wax paper, "tupperware", and lunch boxes to store their lunch items.
  - → eat all the food they take on their trays.
  - → use lunch boxes *or* reuse their lunch bags.
  - → throw their aluminum cans into the cafeteria's recycling bin (a good fund raiser).
  - → take only one napkin.

Custodial/Maintenance Staff:

- Solicit help from classes and/or student clubs in maintaining grounds (picking up litter, tending to shrubs and gardens, etc.)
- Set up a visible place in the school for teachers to put "extra" work sheets. As the number mounts it can serve as a visual reminder to teachers and students.
- Set up area in school building for storage of cardboard boxes for recycling. Every two weeks have one class be responsible for flattening the boxes for recycling.
- Install individual room controls for heating/AC units which teachers can operate. Install ceiling fans to replace AC units.
- Use non-aerosol, non-toxic cleaners.
- Eliminate or reduce use of plastic trash can liners.
- Replace paper towel dispensers in washrooms with cloth roll or warm air type dryers.
- Put trash cans on the playground for candy wrappers, etc.

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III. Educational Activities

All Grades/Classes:

- Develop a recycling display for use during parent-teacher conferences, American Education Week, and other such events. Themes could include:
  Environmental Shopping, Composting, How To Reduce, Reuse, and Recycle, Natural Cycles, Renewable vs. Nonrenewable Resources, Recycling Demonstration, Model Landfill, What Our Community is Doing About Solid Waste
- Have your school give out an annual award for the best classroom resource conservation ideas. Send ideas to the Recycling Education Program at the Wisconsin DNR.
- Make use of foreign exchange students within the school and their cultural information concerning resource recovery in their country.
- Fill washed, empty egg shells with soil and plant seeds. As plants begin to grow the shell and all can be planted — the shell will decompose and nourish the soil.
- For younger students, make instruments from the following materials:
  - Tambourine — 2 aluminum pie tins, paper plates and large bottle caps
  - Castanets — bottle caps, baby food jar lids
  - Banjo — wrap rubber bands around an open cigar or shoe box
  - Maracas — fill small plastic jars with beans or rice
  - Drum — a coffee can or other large can
- Develop a list of environmentally safe school supplies and use them!
- Put posters on the walls of the schools alerting students to practice reducing, reusing, and recycling.
- Plant trees. (Perhaps manage a school forest for pulp trees.)
- Develop Public Service Announcements or Consumer Bulletins and place them in the school or local newspaper and radio stations to educate people about recycling. Some of these could be oriented toward specific target groups.
- Have students make a presentation to the school board regarding recycling policies. For example:
  - → Students can explain what they are doing to conserve in the classroom and to encourage the board to make their policies conservation-oriented.
  - → Students research different areas of waste in your school (food, paper, plastics, etc.), develop and present ideas on how to reduce this waste.
- Have a Reuse Day at school. Have students wear clothing handed down from someone else and bring in materials which have been re-used instead of thrown away.
- Have students research, write, act in, and produce a video tape (15 minutes max.) on:
  Recycling in the home, Composting, Use of alternative products in lieu of harsh chemicals and disposables, Proper disposal of household toxic waste.
- To generate student concern about the issue, show films/videos on the impact of refuse on animals, drinking water, and other resources that directly affect students' lives and interests.
- Go on litter pick-ups regularly and sift through trash to find recyclable materials.
- Design a display on plastic toys that cannot be recycled. Encourage students not to buy these. Make new toys out of old plastic toys or recyclable materials.
- With younger students, collect old tape recorders, record players, clocks, phones, etc., put them on a "take-apart" table, and have students take them apart to see what is inside. Save knobs and other interesting components and conduct an "Invention Convention".
- Teach students how to make a compost pile. Start a compost pile and either sell/give away the compost to a local farmer or gardener *or* use on schoolyard plantings. See page 16 of the Recycling Study Guide for more composting ideas.
- Take your class on a 1-3 mile Ecology Hike or Wellness Walk to a nearby park and collect garbage on the way. Separate the garbage into recyclables and non-recyclables. Celebrate cleaning your area by having a picnic at the park using re-usable and recyclable utensils. Bring the collected garbage back to school and graph what you found. This information can be compared to previous years. Collected garbage can be used for art and other projects.
- Have high school sociology classes design and conduct a survey to help determine what type of recycling program would be best for your school.
- Have older students read **A Sand County Almanac** by Aldo Leopold. Discuss Leopold's views regarding the management and our responsibility for our resources. Pay particular attention to the essay "A Man's Leisure Time". Gary Laib, Poynette High School, Poynette, WI 53955 has an activity guide for this book and essay.

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- Give students addresses of local recycling collection centers and encourage students to take these home to their parents.
- Bury some trash from the classroom in the ground in September and uncover it in May to see how biodegradable each item is. Hang photodegradable plastic where it will have exposure to the sun and monitor its changes.

Art :

- Create "sit-upons" out of cardboard or plastic.
- Teach a unit on product and packaging design which includes design consideration for recycling and reducing packaging materials.
- Design recycling graphics to put on boxes for collection of cans and paper.
- Design new cards and wrapping paper by using pieces of old birthday cards, tissue paper, and grocery bags students bring from home.
- Make puppets from used lunch bags.
- Make "New Depression Art" or "Junk Art" — mobiles, sculptures, robots, etc. — using collected objects.
- Make paper from used paper, cloth, and string. Do paper molding projects or collage art with paper making by adding recycled colorants, such as paints, vegetable dyes, coffee stain, etc.
- Make papier-mache' projects (flower pots, waste baskets, recycling bins) from newspaper.
- Decorate paper bags and use them for collecting recyclables.

Family & Consumer Education

- Develop a unit or module on consumption/waste, it could include:
  - → a concept analysis of the meanings of consumption and waste.
  - → an examination of how culture and background influence attitudes and behaviors of consumption and waste.
  - → a discussion on future trends/prospects of American consumption patterns on resources in the future.
  - → an examination on what the various forms of media portray in regard to consumption, packaging and waste.
  - → a discussion of factors that cause changes in American consumption and waste patterns.
  - → surveys of various age groups for views of consumption and waste.
  - → identification of values/beliefs associated with specific patterns on consumption and waste.
- Set up a home recycling system in class: collect newspaper, aluminum, plastic, tin, glass, etc
- Promote a "waste-less" campaign in the school or community as a class or FHA-HERO project.
- Have students investigate products/items that they buy. Have them check to see if the packaging is recyclable, and if not, what recyclable substitutes can be found.
- Have students develop a list of products that use too much packaging, find the names and addresses of the manufacturers, and write to them expressing their concerns and suggested alternatives.
- Invite a local landfill manager, recycling center operator, waste disposal service worker, etc. to speak on solid waste concerns and ways the community could waste less.

Technological Education:

- Conversion of food by means of methane generation: using food waste from school cafeteria discover how methane gas may be produced. Basic materials — food scraps, livestock manure, water, mixing apparatus, 5 or 10 gallon containers, valves & balloons.
- Conversion of plastic by means of combustion: burn identical weights of different kinds of thermoplastics, determine the combustion efficiency by determining which plastic raises the temperature of a given amount of water the highest.
- Conversion of paper by means of combustion: as for plastics above.
- Recycling paper by means of paper making: use newspaper, magazines, rags, etc. to form new paper from pulp.
- Aluminum recycling by means of casting: melt scrap aluminum in a foundry and cast into new products.
- Build a paper baler or can smasher. See Bame-Cummings Activity Manual, Davis Publications for instructions.
- Conduct an environmental impact study. See **Understanding Technology Activity Guide** by Davis Publications.
- Conduct a home energy audit. See **Understanding Technology Activity Guide** by Davis Publications.
- Solicit old technical journals from local industries for students to use.
- Repair small appliances, lamps, electric motors, small gas engines, etc.
- Refinish and repair wood furniture.
- Build recycling and composting bins for school or community use.
- Build projects with "plastic lumber" made from recycled plastic.

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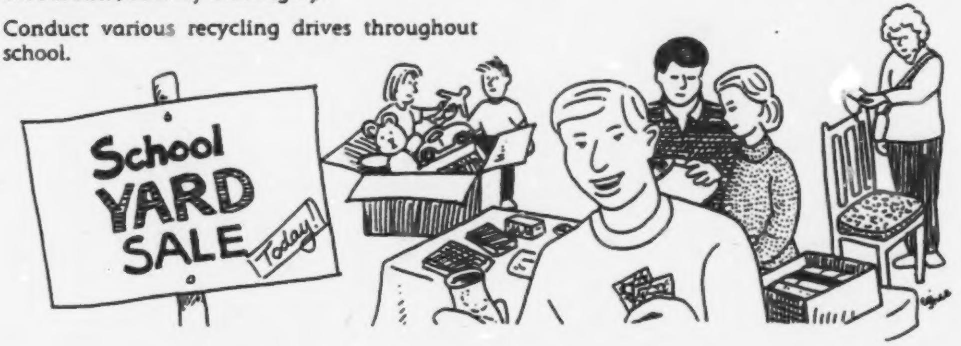
IV. Taking It Further: Special Projects for the School, Community Service, and Fund Raising

- Use recycling as a year-long club project.
- Donate money collected from recycling to:
  Local charities
  Buy bird seed for the school's bird feeding station
  Support school recycling activities
  Purchase equipment for handicapped students
  Support special field trips and projects
  School environmental education activities
  Supporting local, state, or national conservation organizations.
- Develop booklets, coloring books, and skits on recycling.
- Develop a reading area or site in the Library/IMC that would include up-to-date information and articles concerning the solid waste issue and recycling. Include information on selective shopping.
- Recycle old textbooks. See Resources.
- Establish a school account at the local recycling center. Payments for materials brought in by parents and community members can, in this way, be credited to fund school projects.
- Repair toys for school children or an empty stocking club.
- Have a Repair Workshop Day sponsored by the shop class. School and community members can bring bicycles, small appliances, tools, etc. to the workshop for repair. This could be used as a fund raiser.
- Make and sell newspaper logs. Wrap newspaper tightly around a broom stick (use twine or thin wire to hold the roll tight), soak in water, remove broom stick, and dry thoroughly.
- Conduct various recycling drives throughout school.
- Host a technology fair at the high school level. Develop/display new products made from recycled materials.
- Host an art fair featuring art from recycled items.
- Conduct a Recycling Invention Fair or Invention Convention.
- Have students plan and conduct an annual garage sale to encourage re-using.
- Make kitty or "pet" litter and animal bedding from newsprint. Have kids shred the paper, package it, and sell it!
- Repair tools or appliances and give to needy citizens.
- Collect old school books, clothes, and toys for the needy.
- Make reusable shopping bags out of heavy fabric, silkscreen a logo on them and sell them as a fund raiser.
- Make quilted shades for school windows to help conserve energy.
- Use cloth scraps and rags to make rugs, quilts, school banners, shopping bags, and other projects.
- Make recycled holiday cards for senior citizens and needy people to use.
- Collect and distribute magazines for senior citizens and the needy.
- Implement an all-school Project Earth program to last a year. Designate each month for a special topic (Endangered Species Soil, Water, Land Use, Pollution, etc.). Incorporate solid waste management into one of these themes.



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V. Setting Up a School Recycling Program

A school recycling program may not make money, but it will cut down on waste and disposal costs. It also reinforces positive behaviors associated with conserving our natural resources. The school will teach by setting an example and all of society will benefit.

Before you start a recycling program, find out what can be recycled in your community. Check the yellow pages under "Recycling". Call community or private recycling centers and buyers of recycled materials. Your municipality or county may already have a program that you can participate in — call your Departments of Public Works or Solid Waste Management. Finally, your public library has several publications from the Department of Natural Resources that will help you find recycling programs in your community (see Recycling Markets under Section VI, Resources). Next, inventory your school's trash to determine what types and amounts of waste you are generating and what is recyclable. Once you find out what is recyclable in your community and what makes up your waste stream, you can set up your program.

Some helpful hints:

- Before you recycle — reduce the amount of material requiring disposal by avoiding the purchase of disposable items, by buying products in reusable containers or in simple packaging, by buying in bulk and by following the suggestions in the other sections of this pamphlet.
- A school recycling program may be organized through:
  - → school district administration
  - → school building's administration
  - → student council or other student organization
  - → student organization
  - → teacher or class
  - → community recycling project
- If a school wishes to receive financial compensation for recyclables, it may have to deal directly with buyers of recycled materials.
- Program organizers should work with the office, cafeteria, and custodial staff in setting up the project.

- Students can be in charge of most or all aspects of the program including purchasing and waste stream surveys, market analysis, project development, container design and construction, promotion, collection, and monitoring.
- Use a special event or rally to "kick off" the program and provide periodic feedback and recognition to participants.
- Recycling containers should be easy to identify and readily accessible to everyone that needs to use them.
- Although schools generate large quantities of MIXED SCRAP PAPER, it may be preferable to keep LEDGER, KRAFT (brown bags), and NEWSPAPER separate. Check your local markets. LEDGER or white office paper is higher quality and may be the easiest to sell. If this is your most marketable item, consider using white paper for most of your paper needs.
- Make it clear to all participants that certain contaminants common in school facilities must be kept out of recyclable paper: paper towels, facial tissues, cigarettes, cellophane wrappers, stencils, carbon paper, and waxed paper.

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VI. Resources

To Purchase Recycled Paper

Earth Care Paper Products, PO Box 3335, Madison, WI 53704 Phone:(608)256-5522

Riverside Paper Company, PO Box 179, Appleton, WI 54912-0179 Phone:(414)749-2200

State Consolidated Stores, UW-Madison Campus Phone:(608)262-5354

Wisconsin Department of Administration Purchasing Agent Phone:(608)266-2202

Periodicals Containing Recycling Information:

Audubon Activist, National Audubon Society, 950 3rd Ave., New York, NY 10022

Wisconsin Natural Resources Magazine, Box 7921, Madison, WI 53707

Biocycle, Box 351, Emmaus, PA 18049

Garbage, 435 Ninth St., Brooklyn, NY 11215-9937

Resource Recycling, P.O. Box 10540 Portland, OR 97210

Art Projects Using Recycled Materials:

Project Pride, P.O. Box 22, Asheville, North Carolina 28802

To Recycle Textbooks:

Book Value Inc., 238 North Ross Street, Auburn, Alabama 36830. Phone: 205/826-7309.

International Book Project, 17 Mentelle Park, Lexington, KY 40502

Recycling Markets

At your local library:

Community Recycling Activities
Wisc. D.N.R., Publ-SW-032, 1985*

Markets for Wisconsin's Recycled Materials
Wisc. D.N.R., Publ-SW-089, 1989

Wisconsin's Community Recycling Collection Program Directory
Wisc. D.N.R., Publ-SW-033, 1985*

*Watch for annual updates beginning in 1991

At your County Extension Office:

Community-Based Waste Recycling, How to Get Started, Pat Walsh, UW-Extension.

Educational Resources:

Recycling Study Guide, Wisc. D.N.R., Publ-IE-020, 1989

Special Recycling Edition. July-August 1985. "Wisconsin Natural Resources". Vol.8, No.4, Wisc. D.N.R.

Crafts from Trash, Wisc. D.N.R., 1984.

Recycling Facts & Figures, Wisc. D.N.R., 1989.

Recycling Games & Quizzes, Wisc. D.N.R., 1989.

Available from:
Recycling Education Coordinator
Wisc. D.N.R., IE/4
Box 7921
Madison, WI 53707

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Wisconsin Department of Natural Resources
IE/4 Box 7921
Madison, WI 53707

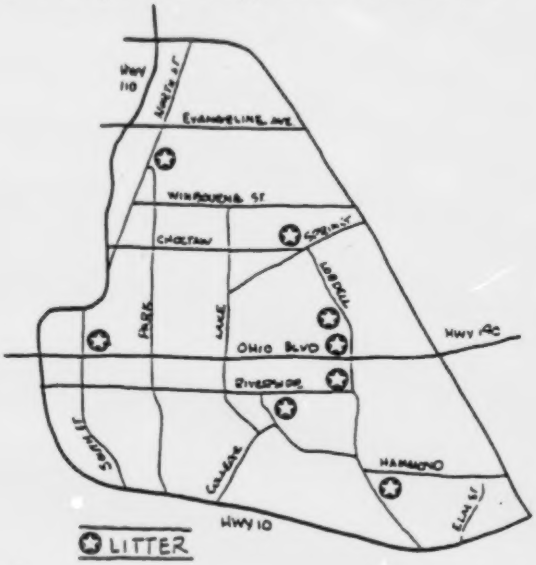
Adopt a Block (A Mile in Rural Areas)

Teachers have an obligation to their students to relate in practical terms the education concepts and skills that they teach. Litter control is a perfect environmental avenue to lead the students out into the community for both the benefit of the student and the community. It also helps improve the positive light in which students are viewed by the residents in a particular area. It gives students an opportunity to do something civic minded, something for the good of others as well as themselves.

It is a common complaint of residents along school routes that some students litter to and from school. Whether or not students are solely responsible for this littering is not the question. The point is that the residents view it as being caused by the students. It is possible to change this negative image into a positive one. **Follow the steps below.**

- Divide the school district or portion of school district into blocks or miles.
- Display a map of the district (or portion) showing the divisions on a centrally located bulletin board.
- Designate areas of high litter concentration with a symbol on the map.
- Check section on motivational ideas.
- Check with municipal, county or state agency responsible for the maintenance of the street, roads and/or highways in your district. Secure a permit if required.
- Have classes, clubs, or ad hoc neighborhood groups adopt-a-block or mile within the designated area to be responsible for its litter maintenance.
- Observe where the litter is being generated - is there a grocery, drugstore or fast food restaurant in the area?
- Approach the local business contributing to the litter stream - Inform them about your school project.
- Work together with the local business. Perhaps you could post litter awareness posters in the store. Have the store clerks remind their customers (particularly those buying small food items) to put their wrappers in a trash can or in their pocket until they see one.
- Measure how much litter is picked up in the initial cleanup of each area by weight.
- Post amounts of litter picked up by each group and area.
- Patrol your adopted block or mile on a regular basis.
- Keep records of amount of litter picked up each time - is it decreasing?
- Vacant lots within your area - try to find out who owns the lot and have them be responsible for its litter maintenance.
- Roadside dumping in your adopted area should be reported to the local health department and monitored by them.
- If large item (stove, refrigerator) removal is the litter problem in your area, seek volunteer help., local government or businesses.

- Have a contest to see which block or mile decreases at the most rapid rate.
- Allow students to devise their own litter control techniques for their areas.
- Form a "Litter Control Exchange" as a place and time where students can share litter control ideas that have worked in their block or mile.



"Looking Good in Ohio Schools"
Ohio Department of Natural Resources
Office of Litter Control
1855 Fountain Square Ct
Columbus, OH 43224

TREE AMIGOS

What You Can Do

Reduce the amount of garbage you generate by purchasing and using products wisely.

- "Precycle" by purchasing products in recyclable containers, such as aluminum, steel, glass, paper and cardboard.
- Purchase foods in bulk or concentrate.
- Avoid plastic and polystyrene (styrofoam) products that are neither reusable nor easily recyclable, such as disposable diapers, lighters, razors and plastic utensils. (Plastics make up 25 percent of our garbage by volume.)
- Make two-sided photocopies.
- Borrow items rather than buy them.
- Share magazine and newspaper subscriptions with friends.
- Keep a cloth towel next to the sink to be used instead of paper towels.
- Reduce the amount of junk mail you receive by contacting Direct Market Association, 6 E. 43rd St., New York, NY 10017, (202) 689-4977.

Reuse products whenever possible.

- Use products that are made to be used many times, such as cloth diapers, cloth napkins, towels and rags, sponges, dishes, silverware, rechargeable batteries, etc.
- Carry a coffee mug with you to use in place of polystyrene cups.
- Bring your grocery and produce bags back to the supermarket and reuse them.
- Use the blank back sides of paper to take notes and do scratch work.
- Mend clothes and repair broken appliances.
- Take care of belongings to help them last longer.
- Look into purchasing used goods at second hand stores and junk yards.

Recycle all materials possible. Many communities have established programs to recycle aluminum, steel, glass, newspaper and cardboard. It is also possible to recycle magazines, colored paper, wood, oil and some plastics.

- Support a bottle bill that establishes a deposit on beverage containers. Bottle bills that call for rewashing and reusing bottles are superior to traditional bottle bills.
- Help establish and promote a curbside recycling program if one does not already exist in your community.
- Organize a recycling program at your school, office, apartment building, church or local government office.
- Make a compost pile to recycle food scraps and yard trimmings. Kitchen and yard wastes make up one-quarter of our waste stream.
- Recycle your used motor oil and car batteries at a local service station.
- Join grassroots organizations that have led the way to increased recycling. (See below)

Encourage the use of recycled products:

- When shopping, look for the recycling symbol (three arrows forming a circle), indicating that the packaging was made from recycled materials.
- Use recycled paper at home and in your office. For every 23 reams of recycled paper you use in place of virgin paper, one pulp tree is saved. For recycled paper contact:
  - Conservatree Paper Co.
    10 Lombard St., Suite 250
    San Francisco, CA 94111
    (415) 433-1000
  - Earth Care Paper Co.
    P.O. Box 3335
    Madison, WI 53704
    (608) 256-5522
- Encourage your local newspaper to use recycled newsprint.
- Encourage companies you do business with to use recycled products.

For More Information

- **Institute for Local Self-Reliance**
  2425 18th St., NW
  Washington, DC 20009
  (202) 232-4108
- Californians Against Waste
  909 12th St., Suite 201
  Sacramento, CA 95814
  (916) 443-8317
- Clean Water Action
  317 Pennsylvania Ave., SE
  Washington, DC 20003
  (202) 546-6616
- Environmental Action
  1525 New Hampshire Ave., NW
  Washington, DC 20036
  (202) 745-4870
- Environmental Defense Fund
  257 Park Ave., South
  New York, NY 10010
  (212) 505-2100
- Kentuckians for the Commonwealth
  425 W. Muhammed Ali Blvd.
  Suite 328
  Louisville, KY 40205
  (502) 585-3279
- Long Branch Environmental Education Center
  Route 2, Box 132
  Leichester, NY 28748
  (704) 683-3662

"Recycling Fact Sheet"
Earth Day 1990
P.O. Box AA
Stanford, CA 94309

POLLUTION POINTERS
FOR
ELEMENTARY STUDENTS

You can help make the world a cleaner place. One way to start is by performing simple projects at home and in your classroom. Here are some suggestions. You can probably think of more.

1. Litter Art Show. Make a display of mobiles, collages, or sculptures made from pieces of litter. Give awards for the prettiest, most functional, and most unusual.

2. Fancy Cans. Decorate litter barrels that have been placed in your community by the parks and recreation department. Used drums may also be available from supermarkets, car washes, schools, hospitals, or manufacturing plants. Decorate them and put them out.

3. Walk. Have an adult walk with you to activities that are nearby, instead of asking for a ride in the car. Have your friends ride with you, too. The less a car is used, the more your family contributes to clean air and energy savings.

4. Pollution Pin-Ups. Start an ecology bulletin board. Pin up magazine pictures of areas that have been spoiled by pollution, and clean areas.

5. Paper Is Precious. Use it wisely. Write on both sides of the page. Don't use a fresh sheet for scratch paper. Ask your teacher to start a paper recycling project.

6. Save Some Electricity. Turn off lights, television, and the radio when no one is in the room. Don't leave the refrigerator door open. This will save electricity and keep the air clean.

7. Take A Field Trip. Ask your family or teacher to take a field trip to a center where recyclable items are collected. Or visit a sanitary landfill.

8. Name Those Tunes. Make a list of all the songs you know about our land, such as "America the Beautiful." Or write your own songs.

9. Don't Hurt Trees. Carving your initials on trees allows bugs and diseases to get under the bark and ruin a healthy tree. Peeling the bark off a tree will kill it, too.

10. Rap Session. Describe the most littered place you have ever seen. Why was it dirty? Tell about your favorite place and why it is so nice.

Keep America Beautiful Inc.
Mill River Plaza
9 West Broad Street
Stamford, CT 06902

11. Start a Forest. You may be able to get tree seedlings from a garden center or state agricultural office. Or grow your own seedlings in milk cartons and flower pots from acorns and pine seeds. Plant them in your yard or at school. Trees create oxygen and help cool the Earth.

12. Hold a Contest. Award prizes for the best poster, poem, song, or skit about the environment. Arrange to show the posters in school halls or in store windows.

13. Create Quiet. If you carry a radio, keep the volume low. It's all the louder-than-necessary sounds that create noise pollution.

14. Live Litterbug. Prepare a "Live Litterbug Container" with a sign that says "See the litterbug here!" and place it in your classroom. A mirror at the bottom reflects the litterbug.

15. Dump It All. When you take out the garbage, be sure that it all goes in the garbage can. Put the lid on tightly. Loose trash becomes litter.

16. Make A Booklet. Describe the environment with cut-outs, articles, pictures, and suggestions for cleaning up the environment.

17. Make Litterbags. Give them to your teachers and friends.

18. Use Litterbags. Put them on your bicycle and in your school locker. Ask your parents to put a litterbag in the car.

19. Write a Story Called "Litterbugs Are Bad." Why didn't the litterbug in your story use a litter basket? What could have been done to stop him from becoming a litterbug?

20. Recycle At School. Ask your teacher to help your class start a recycling project in the classroom. Find out if your school is buying recycled paper.

21. Recycle At Home. If there is a recycling center in your community, collect recycable items yourself and turn them in. Ask your family to help.

22. Write a Play About Pollution. Present it at an assembly or for your family and neighbors.

23. Make Bookmarks. Write "Don't Litter" on them and give to students.

24. Do a Little "Litter Bit" More. If you see a piece of litter on the ground, pick it up and put it in a litter receptacle. If everyone picked up one piece of litter each day, think how much cleaner our streets and public lands would be.

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Tips For Preventing Litter in Your Town

WHY DO PEOPLE LITTER?

Litter is misplaced, improperly handled solid waste. In a three-year research project, Keep America Beautiful, Inc. found that three attitudes predominate most people's thinking about handling waste. They feel it's O.K. to litter:

- where they feel no sense of ownership for the property
- where someone else will clean up after them
- where litter has already accumulated

WHERE DOES IT COME FROM?

Although motorists and pedestrians are most often blamed for litter, Keep America Beautiful identified seven sources that contribute to the problem. They are:

- commercial refuse sources, including dumpsters
- household trash handling
- construction/demolition sites
- uncovered vehicles
- loading docks
- motorists
- pedestrians

From these sources, litter is carried in every direction by wind, water, and traffic. It moves until trapped by a curb, wall, fence, a row of trees, a building, or other stationary object. Once trapped, litter becomes not only an eyesore, but an invitation for people to add more.

THE COST OF LITTER

Litter is a costly problem. City, county, and state highway departments spend millions of dollars and many hours each year cleaning up litter – money and time that could be used for more needed services. In Texas, $20 million is spent annually to remove litter from roadsides. In Georgia, 500 workers attack the litter problem along state roads each day. Cleaner communities also have a better chance of attracting new businesses than those where litter is common.

There are many things we can do to improve our waste handling practices and reduce litter. The tips on the back of this sheet describe a number of these activities.

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9 West Broad Street
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12 WAYS THAT YOU CAN PREVENT LITTER

There are many ways that you can help make your community cleaner. Here are 12 suggestions:

- Set an example by not littering.
- Pick up one piece of litter every day.
- Teach your children the proper way to dispose of their trash. Show them the difference between a clean area and an area spoiled by litter and stress ways they can prevent litter.
- Make sure that your trash cans have lids that can be securely attached. If you have curbside trash collection service, don't put out open containers or boxes filled with trash.
- Carry a litterbag in your car. Ask local businesses to buy car litterbags and distribute them to customers. Encourage them to print their name and an environmental message on the bag.
- Ask your neighbors to join you in cleaning up one public area where litter has accumulated. Ask your local Department of Public Works to become involved by collecting the bags of litter, or by waiving the disposal fee at the landfill or solid waste facility.
- Start a litter receptacle fund drive to place more litter baskets around your community.
- If you or a member of your family is involved in a civic group, scouting, or recreational sports program, encourage the group to become involved in a cleanup. In some communities, groups can earn cash by separating recyclable products from litter and redeeming them. Or have the group "adopt" a spot and maintain it on a regular basis.
- Find out how you can plant and maintain flowers along a curb or sidewalk. People litter less where areas have been beautified.
- Ask business owners to check their dumpsters every day to make sure tops and side doors are closed. If they have a loading dock, ask them to keep it clean and put out a receptacle for employees to use.
- If you own a construction or hauling business, make sure your trucks are covered when transporting material to and from sites. Use snow fencing around construction or demolition sites to prevent debris from being blown to other areas. Put trash containers on every floor for construction workers.
- Ask a local Chamber of Commerce or civic group to start an awards program that recognizes individuals, groups, and businesses for their litter prevention or beautification efforts.

The most successful way to prevent littering in your community is to have an ongoing, organized program that involves local government, businesses, civic groups, the media, schools, and private citizens.

Keep America Beautiful offers communities of every size such a program, the KAB SYSTEM. The SYSTEM trains local leaders and residents to respond to improper solid waste handling practices and to sustain a program's litter reduction. The SYSTEM was introduced by Keep America Beautiful in 1976 and is now in place in over 450 communities and 17 states nationwide. The SYSTEM has been shown to reduce litter by an average of 49% after a community has been an affiliate of KAB for three years, and by up to 88%.

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ENVIRONMENTAL ACTION STARTS HERE

A Youth Group Leader's Guide

A PLACE TO START

Litter is one pollution problem everyone can do something about. It may not be the most serious threat facing our environment, but any pollutant that drains millions of dollars a year from the economy isn't a minor problem.

Litter pollutes the land and water. It attracts rats, feeds fires, causes accidents and degrades neighborhoods. Littered parks and beaches are no fun. It's hard to commune with nature when the great outdoors is covered with trash.

Litter doesn't throw itself on the ground. People create litter and only people can eliminate it.

If your group cares about the ecosystem, stash your trash and pick up litter. This is where the action begins.

FIRST THINGS FIRST

If we change attitudes--first our own, then those of the people around us--we can solve the litter problem and begin to meet the total pollution crisis.

Here's a checklist your members might use to examine their own attitudes.

1. Near my home litter is: a minor problem; a catastrophe.
2. I litter because: I can't find a trash receptacle; I don't care; I never realized litter was a pollutant.
3. If I saw someone littering I would: tell him to pick it up; pick it up myself.
4. Litter prevention is: not very important; my responsibility; a place to start.

If each member completes the checklist anonymously, the tabulated results could provide the basis for a discussion on litterers and litter prevention projects.

THE NEXT STEPS

Actions speak louder than almost anything. Here are some projects that have worked. They can be adapted to meet the needs of your community and the interests of your members.

ADOPT-A-PLOT. Pick one spot--a neighborhood park, a ski slope, a nearby beach--and go all out to keep that area litter free. Get permission from the proper authorities and hold a clean-in, install trash baskets, post anti-litter signs and provide maintenance. If possible, plant trees and flowers to discourage littering, brighten the landscape and increase oxygen in the air.

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LITTER SPOILS LEISURE. Make litter prevention a part of recreational activities. Clean the underwater area while scuba diving. Combine a camping trip with a cleanup. With permission of the proper authorities, install appropriately decorated trash barrels on a lake shore; clean up a beach and use the the collected trash, piled behind wire, to remind bathers not to litter. Later, dispose of the pile properly.

IT PAYS TO ADVERTISE. Using iron-on tape, or indelible ink, decorate sweatshirts, ski jackets, jeans or knapsacks with "Lug it, don't leave it," "I stash MY trash," or other appropriate slogans. Wear them whenever you are in public together as a group.

POLLUTION SOLUTION CONTEST. Ask a local newspaper or radio station to co-sponsor a contest that will draw attention to the proper way to dispose of trash. Arrange to have a prominent community figure--a deejay, public official, athlete--put something in a litter basket each time he goes out. Offer a prize to the first person who asks him, "Are you the pollution solution?"

DESIGN DERBY. Hold a contest for the most effective trash can design. Using any large containers, from ice cream cartons to clean grease drums, have contestants decorate them with compelling slogans and/or designs. Get permission from the proper authorities to place the decorated cans on sites where litter usually accumulates.

PLAYGROUND PATROL. Wearing do not litter shirts or some other identifying garb, visit a play area and enlist the children in the campaign against land pollution. Ask them to sign pledges to not litter. Help them to make litter prevention posters and arrange to have their work displayed in nearby stores.

PRACTICAL POLITICS. Using campaign materials, decorate large paper sacks as litterbags for political workers to take with them when they distribute election literature.

CASH FOR TRASH. If there are reclamation centers in your community, a drive to collect aluminum products, bottles, cans and newspapers can help to increase your group's treasury and cut down on litter and solid waste.

AND YOU MIGHT TRY...

- Making litterbags to pass out at a holiday parade.
- A half-time trash collection at a sporting event. Arrange for an announcement on the public address system. Pass through the crowd with large litterbags.
- Planting flowers, bushes or trees in some neglected spot.
- A canoe trip combined with a cleanup.
- A "street theater" anti-litter play.
- All day house "paint-in" for a deserving person.

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- Handing out "thank you for helping the environment" cards to passersby when they put trash in receptacles.

WHERE YOU'RE AT

After you have carried out a project, evaluate your efforts. Was it well planned, or did you forget something vital, like getting permission to install the decorated trash cans? Was everyone in on the planning or did you miss the best idea of all because someone didn't speak up until the activity was over? Have your own attitudes toward littering changed? Is the community cleaner? Where are you going from here?

LOUD AND CLEAR

Publicity helps get your message across. Almost any environmental action program provides good copy for newspapers, radio and television. Ask the media to publicize your litter prevention program. Provide them with reports and photographs of your activities.

* * * * * * * * *

Keep America Beautiful, Inc. formed in 1953, is a non-profit public service organization dedicated to building a national cleanliness ethic through improved waste handling practices at the community level.

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Mill River Plaza
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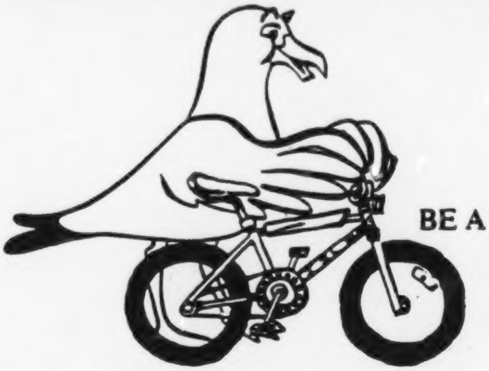
Here's how you can help the environment by reducing waste:

1. Take small portions of food and go back for "seconds" if you are still hungry. Put leftover food in reusable storage containers to eat later.
2. Buy or make up your own "picnic basket" that includes reusable cups, plates, and silverware. Look for these items at garage sales.
3. Buy a lunch box and be cool. Get your friends to use lunch boxes too. Pack your food in reusable containers instead of waxed paper, sandwich bags, or aluminum foil. It will stay fresher and will not get "squished"!
4. Collect and recycle aluminum cans. Aluminum is a very valuable metal and is easy to recycle. Recycling one aluminum can saves enough energy to keep a light bulb lit for 12 hours!
5. Use both sides of a piece of paper when writing letters or doing homework. If you only need to use one side, save the paper in a "reuse" box for future use. Make your paper last twice as long.
6. Use a pencil and erase any mistakes. If you need a perfect copy, practice on one of the papers from your "reuse" box and then copy it over.
7. Save your old clothes for a garage sale or give them to a charity. If they are ripped or torn and cannot be repaired, then use them for cleaning rags (cut off and save the buttons first).
8. Litter is everybody's problem and responsibility. Do your part by picking it up and disposing of it properly—perhaps even recycle it.
9. If possible, buy soda in returnable glass bottles and return them! If only plastic soda bottles are available, do not throw them away. In many communities, they are recyclable.
10. After you buy a small item, take it home in your pocket. You do not really need a bag. If your items are too large for your pocket, then bring a reusable shopping bag you've made.
11. Buy in bulk or buy larger packages and put the amount you need for school or snacks in reusable containers. Buying in bulk is usually cheaper than buying individually wrapped servings and requires less packaging.
12. Use a hand towel for drying your hands and a dish cloth or sponge for wiping up spills. They can be cleaned and used again instead of being used once and thrown away.
13. Do not throw away glass bottles and jars. These can be recycled in many communities. Many can also be reused for storing different things.
14. Make your plane with a piece of paper from your reuse box and save the clean sheet of paper for writing.
15. Save broken crayons in a can for future coloring or art projects. Buy a crayon sharpener to make points on rounded edges.

TREE AMIGOS

"K-3 Supplement to the Recycling Study Guide"
Wisconsin Department of Natural
Resources Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707



BE A CONCERNED CONSUMER

You *DO* Have a Choice

1. Shop for durability. Buy products with long-term value. Read and evaluate the warranty.
2. Look for products in recyclable, returnable or refillable containers whenever possible. Buy soda in easily recycled aluminum cans or returnable bottles rather than the more problematic plastic bottles.
3. Avoid excessive packaging. Buy products in bulk and in larger sizes. For example, a seven ounce tube of toothpaste uses 50% less packaging per ounce than the three ounce size.
4. Avoid disposables such as throwaway pens, lighters, razors. Some disposable items actually cost more than their more durable counterparts. 90 cloth diapers from a diaper service cost about $10 per week. The same number of disposable diapers cost at least $16 per week.
5. Support recycling. Separate your cans, bottles and newspapers. Encourage your friends and neighbors to do the same.
6. Buy products packaged in recycled paper and carry them home in paper bags. In fact, buy recycled paper for all your paper needs.
7. Use less paper. Turn the paper over – use both sides. Make memo pads or scratch paper from discards. Ask yourself if you really need ten copies.
8. Buy products that can be repaired. Avoid those that carry the label "no owner serviceable parts."
9. Consider reuse of purchases. How about batteries that can be recharged? Children's clothing or toy exchanges? Yard sales?

TREE AMIGOS

"Oscar's Options"
83 Park St
Providence, RI 02903

ADDITIONAL CLASSROOM AND OUTSIDE ACTIVITIES

1. Survey home for common household waste that may be considered hazardous. Use survey form and classify as to type. Compare results. Determine the most common type and devise a safe method for disposal.

2. Interview (or invite to class) a senior citizen to find out about his childhood experiences with hazardous waste. Compare what we know about hazardous waste today with what was known in the past.

3. Survey local stores and observe packaging of materials. Classify as: convenience, superflous, or essential packaging.

4. Compare three standard picnic baskets emphasizing:
   1) *low cost*, 2) *convenience*, 3) *low environmental impact*.
   - Basket one could contain home wrapped sandwiches, bagged potato chips, canned soda and candy bars. Basket two could contain a lunch from a fast-food restaurant chain which uses considerable paper packaging. Basket three should contain foods which leave little or no waste such as apples, carrots, cheese, etc.
   - Compare the waste produced by each and discuss the implications about our lifestyles.
   - Eat the picnic foods.

5. Have students write a poem or short story on the subject of "how my generation improved the earth."

6. Form a "web of life" using string and allowing students to represent animals, food sources, industry, etc. Discuss how the alteration of one member affects all members of the community.

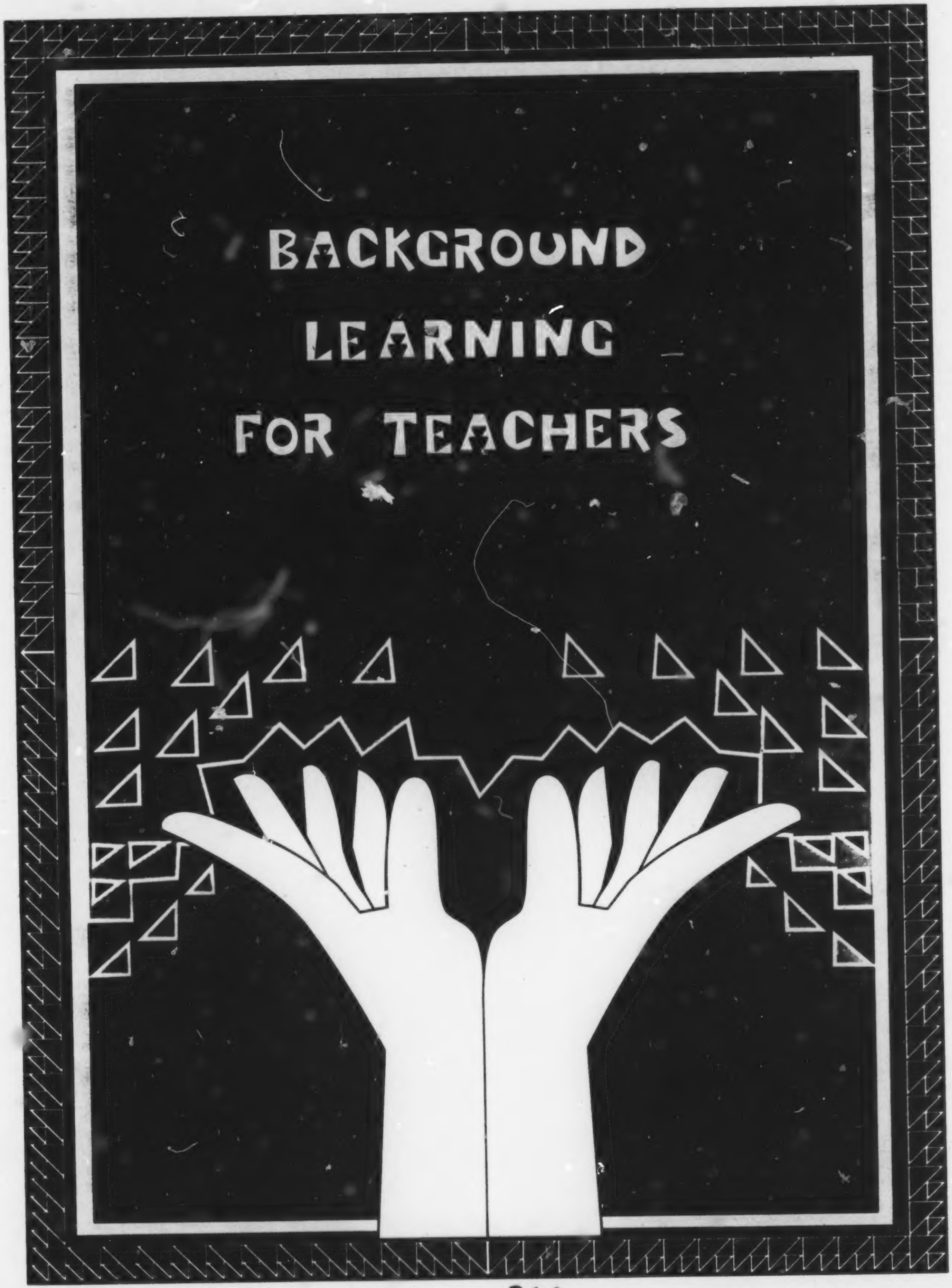
7. Discuss available jobs that have to do with waste management. For example, engineers design landfills.

8. Organize a community clean-up campaign. Students can advertise the clean-up event, help collect the trash and help transport it to a proper landfill.

9. Have students identify a waste problem in our community and design a plan to resolve it. Stress that students should not move or touch abandoned items suspected of being hazardous waste. Review what authorities to contact if such a discovery is made.

"Reduce, Reuse, & Recycle Activities For All Grades"
Waste Education Clearinghouse
Office of Waste Management
1350 Energy Lane
St. Paul, MN 55108

BACKGROUND LEARNING FOR TEACHERS



BACKGROUND LEARNING FOR TEACHERS

Materials in this section will help you learn more about a variety of subjects which can be related to Tree Amigos Learning Activities and Action Projects. Some may serve as hand-outs for advanced junior high and high school students.

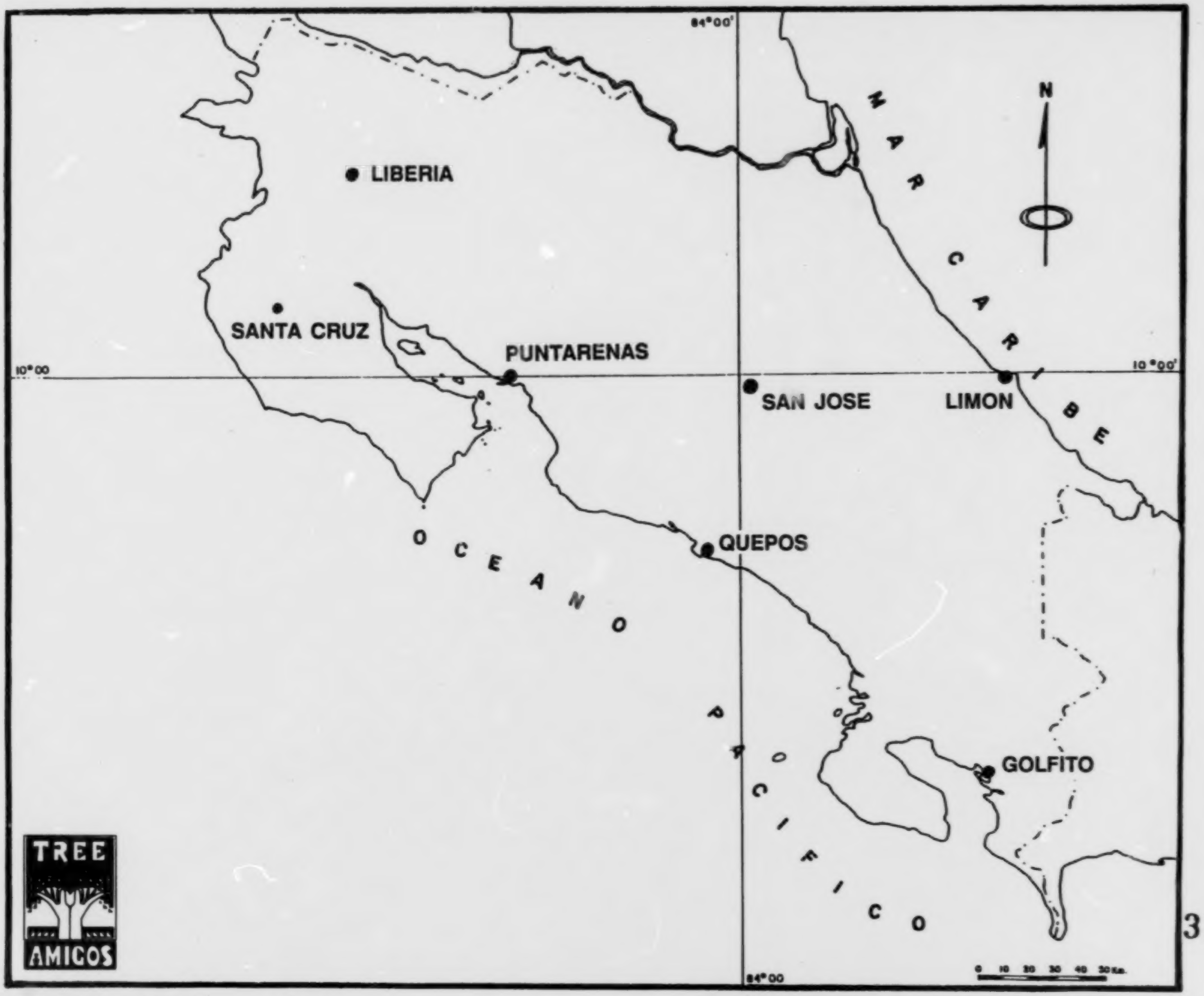
COSTA RICA

Costa Rica is the oldest democracy in Latin America. Preferring to emphasize the human needs of its people, Costa Rica abolished its armed forces in 1949. The government devotes its resources to education, health, housing and other social programs.

Costa Rica is a nation of 2.7 million people in an area roughly the size of Lake Michigan. Its literacy rate of 95% is one of the highest in the Western Hemisphere. Costa Rica also has the best-equipped hospitals in Central America and one of the lowest infant mortality rates in the world. These accomplishments demonstrate convincingly what can be achieved by a nation that treats peace and human rights as its highest priorities.

In addition to its social and economic goals, Costa Rica actively pursues a national conservation strategy. Setting aside over 30% of its land as protected wilderness and reserves, Costa Rica has opted to live harmoniously with nature. Costa Rica is a training ground for young naturalists from all over Latin America. Its conservation programs are becoming models for the developing nations. Because Costa Rica is a relatively safe, hospitable place for scientists and contains impressive biodiversity, it has also become the research site for scientists from all over the world.

As a nation with over 100 years of democratic life, Costa Rica's strength is measured in peace rather than military might. Sharing borders with Nicaragua to the North and Panama to its south, Costa Rica is an "island of peace" in a region embittered by fighting.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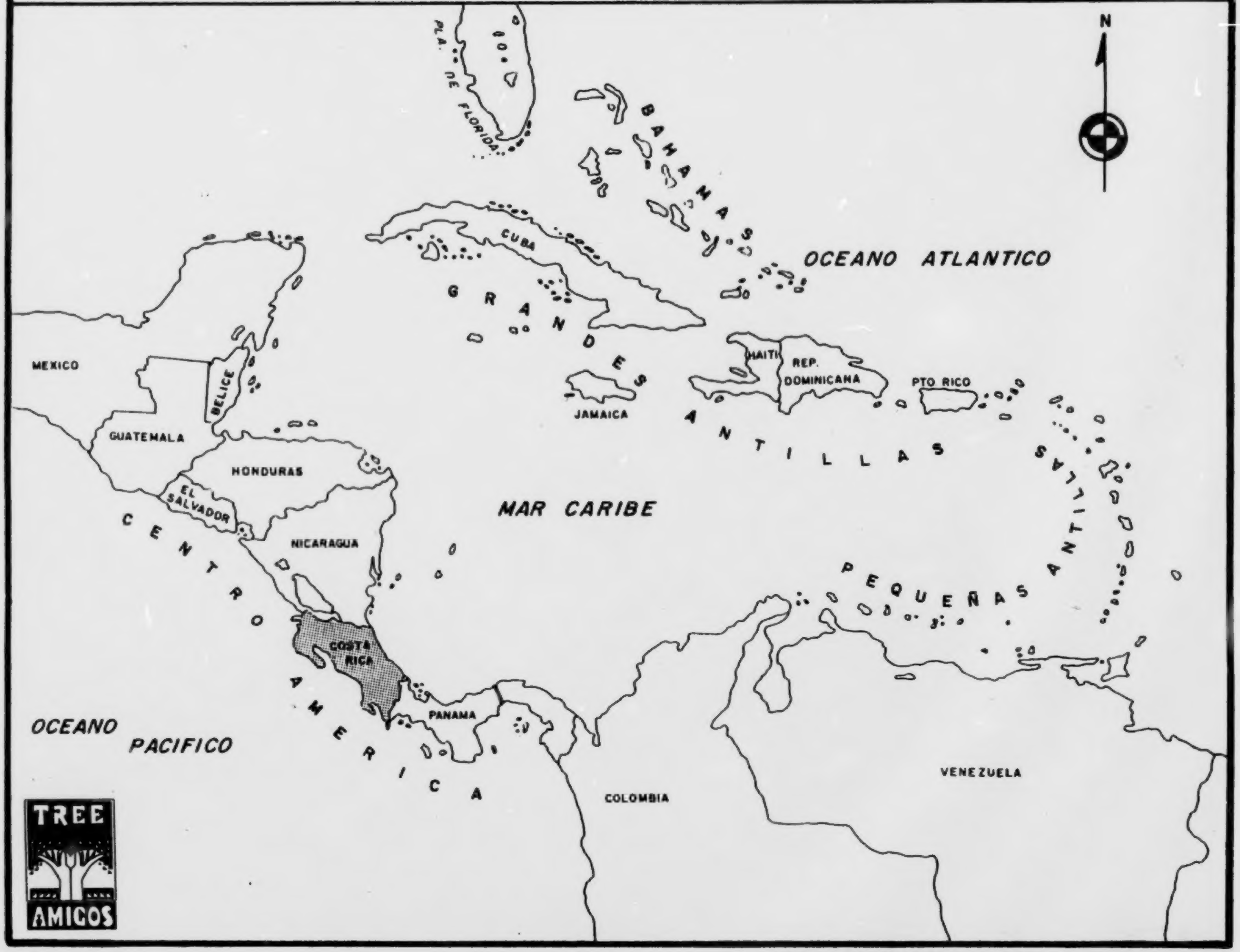
COSTA RICA

Adapted from COLORCROQUIS DE COSTA RICA - LEHMANN

COSTA RICA (IN RELATION TO THE CARIBBEAN)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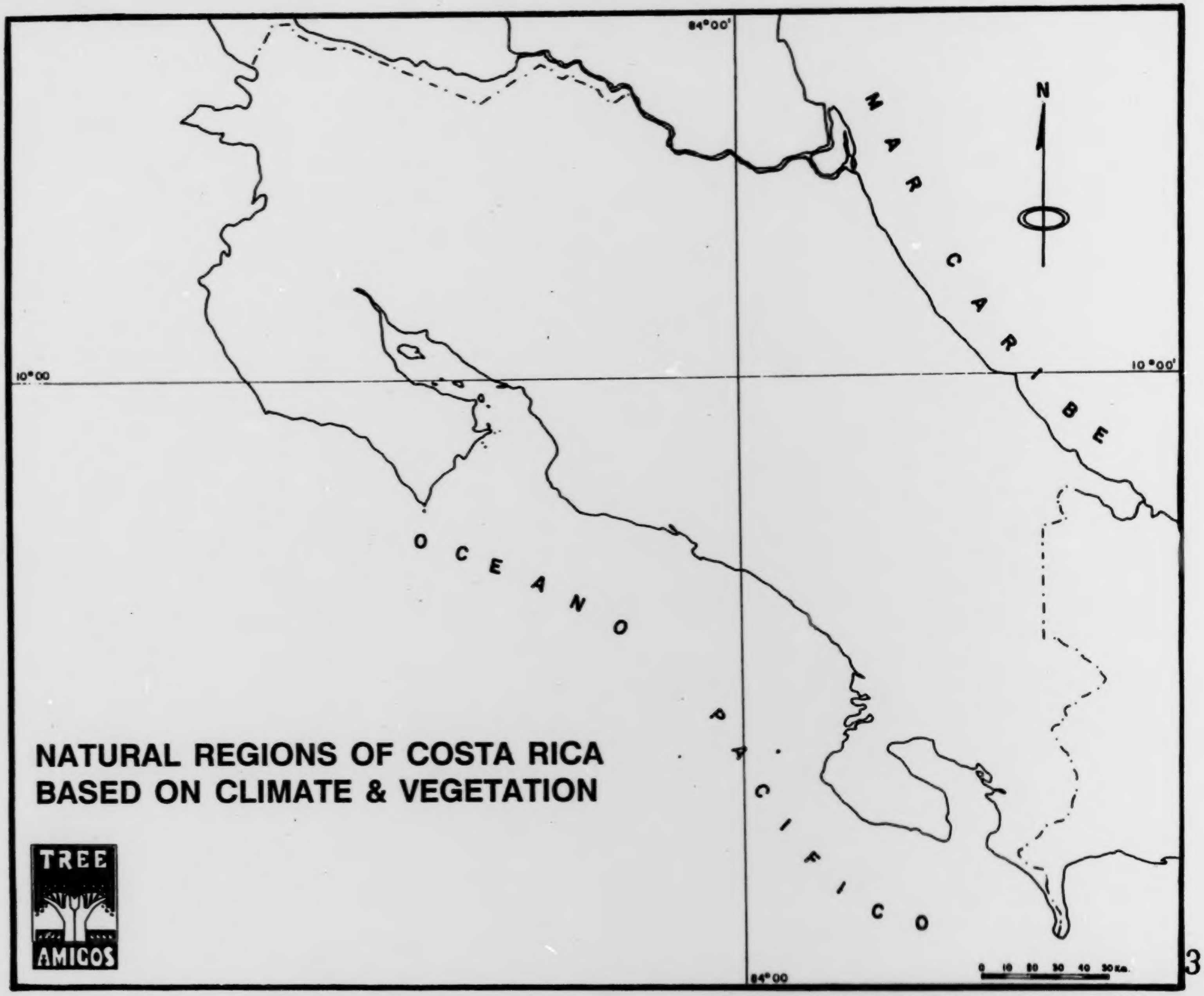
COSTA RICA
PANAMA
CENTRO AMERICA
OCEANO PACIFICO
COLOMBIA
VENEZUELA
TREE
AMIGOS

Adapted from COLORCROQUIS DE COSTA RICA - LEHMANN

NATURAL REGIONS OF COSTA RICA BASED ON CLIMATE & VEGETATION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Adapted from COLORCROQUIS DE COSTA RICA - LEHMANN

LEARNING ACTIVITY: *The Geography of Costa Rica*

OBJECTIVES: *The student will be able to:*

1. *Locate Costa Rica on the North American Map.*
2. *Describe the topography of Costa Rica.*
3. *Describe the climate of Costa Rica.*
4. *List the five factors that affect climate.*
5. *Explain how elevation affects the climate of Costa Rica.*

MATERIALS: *Laminated Maps of Central America*
Hand-outs

AGE: *Seventh grade and up*

DESCRIPTION: *This mapping activity will introduce students to Latin American geography and to teach students the relationship between elevation and temperature. The geographic themes of location and place are explored. Designed by Pete VanEnk, Michigan Geographic Alliance and City High Middle School, Grand Rapids, Michigan.*

DIRECTIONS:

1. Using the laminated maps of Central America, locate the major physical areas in Latin America. (Use hand-out if necessary)
2. Read the hand-out on the factors that affect climate.
3. Locate the specific areas in Costa Rica and describe the climate of Costa Rica. (Use hand-out if necessary)
4. Read and discuss the hand-out on elevation and temperature. (See reverse)
5. Using the maps of Costa Rica (elevation, political, population). Discuss possible relationships between topography, climate and land.

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AMIGOS

ELEVATION AND TEMPERATURE: WHAT IS THE RELATIONSHIP?

Most people think that near the equator it is always very hot. For the most part they are correct. Elevation, however can be alter the climate of a place no matter where it is on the earth. Generally, the higher in elevation a place is the cooler it is. For every 1000 feet the temperature drops between 2 and 4 degrees. Although people along the equator live in many different areas they usually gravitate to the highlands. People living in the low latitudes of Latin America have given special names to temperature areas according to elevation. Costa Rica is located between 9 and 12 North of the Equator, and its climate is affected by elevation. Use the chart below and your maps of Costa Rica to suggest the best places for people to live.

ZONE	ELEVATION	AVERAGE TEMP.	CROPS GROWN
Tierra Caliente	Sealevel- 300 ft.	75-80 Degrees F	Sugar Cane Rice
Tierra Templada	3000 Ft.- 6000 ft.	65-75 Degrees F	Corn Coffee Bananas Citrus Fruit
Terra Fria	6000 Ft.- 10,000 ft.	55-65 Degrees F	Potatoes Grains
Puna	10,000 ft.- 14,000 ft.	25-55 Degrees F	Grazing
Terra Helada	Above 14,000 ft.	Below 20 Degrees F	Little or no Vegetation

PHYSICAL GEOGRAPHY OF LATIN AMERICA

I. MEXICO

A. **SIERRA MADRE ORIENTAL** - Mountain range along the Eastern Coast.

B. **SIERRA MADRE OCCIDENTAL** - Mountain range along the Western Coast.

C. **ISTHMUS OF TEHUANTEPEC** - Narrowest part of mainland Mexico.

D. **YUCATAN PENINSULA** - Area north of Belize

E. **BAJA CALIFORNIA** - Narrow strip of land south of California and west of mainland Mexico

F. **MEXICAN PLATEAU** - Area between the Sierra Madre Oriental and Sierra Madre Occidental

II. SOUTH AMERICA:

A. **ANDES MOUNTAINS** - Mountain range located along the western coast.

B. **AMAZON BASIN** - Low area drained by the Amazon River.

C. **GUIANA HIGHLANDS** - Highland area in southern Venezuela and parts of Guyana.

D. **BRAZILIAN HIGHLANDS** - Highland area in southeastern Brazil along the coast.

E. **PATAGONIA** - Highland area in southern Argentina.

F. **PAMPAS** - Plains area in Central Argentina.

G. **LLANOS** - Lowland area in Columbia and Venezuela.

H. **GRAN CHACO** - Lowland in western Paraguay, northern Argentina, and southern Bolivia.

FACTORS THAT AFFECT CLIMATE

1. **LATITUDE:** Generally speaking the closer the area is to the equator the warmer that area will be. The direct rays of the sun are the hottest and these fall between the tropic of cancer and the tropic of capricorn. The indirect rays give off less heat and thus as one travels toward the poles it gets colder and colder. Geographers have identified three major latitude belts:

    A. **THE LOW LATITUDES** (30 degrees north - 30 degrees south) AND WARM YEAR ROUND.
    B. **THE MIDDLE LATITUDES** (30 degrees north - 60 degrees north, 30 degrees south - 60 degrees south) HAVE WARM SUMMERS AND COLD WINTERS.
    C. **THE HIGH LATITUDES** (60 degrees north - 90 degrees north, 60 degrees south - 90 degrees south) ARE COOL TO COLD ALL YEAR.

2. **NEARNESS TO WATER:** Because water heats up and cools off slower than land water has a moderating affect on the land areas surrounding bodies of water. Land near bodies of water tend to be warmer in the winter and cooler in the summer.

3. **MAJOR LAND FORMS:** Mountains have a tendency of blocking major weather patterns. The windward side of mountains get more precipitation than the leeward side.

4. **OCEAN CURRENTS AND WINDS:** In certain locations on the Earth ocean currents flow near land. Depending on where the ocean current originates it can bring either warm or cold water near the land area. Winds blowing inland over the water can either warm or cool the coastal areas.

5. **ELEVATION:** Generally speaking the higher the elevation of an area the colder it will be. For every 1000 feet of elevation the air temperature decreases 3-4 degrees.

III. COSTA RICA

1. **CARIBBEAN LOWLANDS** - Lowland area along the coast of the Caribbean Sea. Land of tropical jungles with temperatures between 80 degrees Fahrenheit and 100 degrees Fahrenheit and up to 300 inches of rainfall per year.

2. **CENTRAL HIGHLAND** - (Meseta Central/Central Valley) Volcanic area around San Jose, the capital of Costa Rica. Area of fertile farm land. 50% of the people live here. Temperatures between 68 degrees Fahrenheit and 80 degrees Fahrenheit. Chief coffee growing region.

3. **TALAMANCA RANGE** - Mountain range area southwest of San Jose. Continues all the way into Panama. Sparsely populated.

4. **PACIFIC COASTAL STRIP** - Lowland area along the coast of the Pacific Ocean. Ideal for growing bananas. Temperatures between 90 degrees Fahrenheit and 110 degrees Fahrenheit.

5. **GUANACASTE REGION** - Northwest Pacific Region. Dry tropical forest. Dry season may last for 6-8 months. Cattle ranching and tourism along the Pacific beaches.

TREE AMIGOS ACTIVITY

GEOGRAPHY & ECOLOGY

Rules Governing How The World Works

PLACE

1. Matter is neither created nor destroyed, but merely changes form.
2. All life and all forms of food begin with sunlight and green plants.
3. Energy is neither created nor destroyed, but merely changes form.

LOCATION

4. Because of cosmic factors, matter, energy, and food are distributed unequally over the earth.

REGION

5. The existence, abundance and distribution of any organism is determined by the least available essential resource or interacting organism.

MOVEMENT

6. Places are connected with other places.

HUMAN-ENVIRONMENT RELATIONSHIPS

7. Total Human = Population x Consumption x Impact per Unit
   Environmental per person Consumed Impact

8. In looking at our human environmental impact, we face three major dilemmas:

   - The Growth Dilemma
   - The Distribution Dilemma
   - The Control Dilemma

Prepared by Dr. Mike Libbee, Michigan Geographic Alliance

13

everything is hitched to everything else: ecology by day & night

"When we try to pick out anything by itself, we find it hitched to everything else in the universe," said John Muir, the renowned naturalist. The natural world is made up of innumerable, intricate interrelationships, like the widening and intermixing ripples caused by raindrops falling in a placid pond. Any small change in an interrelationship causes a series of repercussions in ever-widening areas. A volcano erupts, and volcanic ash is spread through the atmosphere thousands of miles away. A housing development is built in a wetland, which may change the watertable and increase flooding in some distant area. Also, the destruction of the wetland's natural plant and animal community will cause readjustments in neighboring ecosystems—readjustments that in turn will affect others in ever-widening areas.

Ecology means the relationship of organisms to each other and to their environment. The word *ecology* is derived from the Greek, *oikos*, meaning household, and in this instance, the household is the whole earth. Interrelationships are central to an understanding of ecology, and these interrelationships depend on the adaptations of plants and animals for their life needs and on the changes continually occurring in the natural world. A tree falls in the forest. What might happen to the shade-tolerant species that had been growing underneath it, or to the eggs in the bird's nest that fell with the tree? Older children can comprehend the concept of ecology, but it is generally difficult, if not impossible, for elementary school children to absorb the concept. (Complex ecological relationships are often not understandable until a child is in high school, and some are difficult even for adults to comprehend.) However, concrete examples, such as the changes that could result from that tree falling, illustrate the concept. Such examples will build a basis for a child's future theoretical understanding of ecology and its significance to us all.

No ecosystem, no life anywhere on earth, could exist without the sun. The sun's energy is vital to the process of photosynthesis, which produces the basic food of all life. The sun also warms the earth, making it habitable, while it warms the air of the atmosphere. The effect of the sun's warmth on air is one factor that causes varying weather conditions. These different weather conditions, and the resulting differences in climate, have direct influences on plant and animal life. Palm trees cannot live in the arctic and polar bears cannot survive the heat of the tropics.

Air, water, and the materials of the earth are necessary for life as we know it. The oxygen and carbon dioxide in air are used by plants and animals. Life began in water, and without water, plants and animals cannot live. Most plants need soil for growing, and the type of plant that may grow in a given area depends on the makeup of the soil as determined in part by the minerals contained in the underlying bedrock. Since animals depend on plants for food, the components of soil indirectly influence the animal life of an area. The rich, deep soils of the prairie support an abundance of grasses, which support many grazing animals and their predators—quite a different ecosystem from a dry, sandy desert area where vegetation is sparse and animal populations relatively low.

Variations of sunlight, weather, climate, soil, and water, therefore, determine the types of plants and animals that can live in a habitat. These plants and animals develop interrelationships between themselves as well as with the habitat,

"Nature With Children of All Ages"
Edith A. Sisson
Massachusetts Audubon Society
Prentice-Hall, 1982

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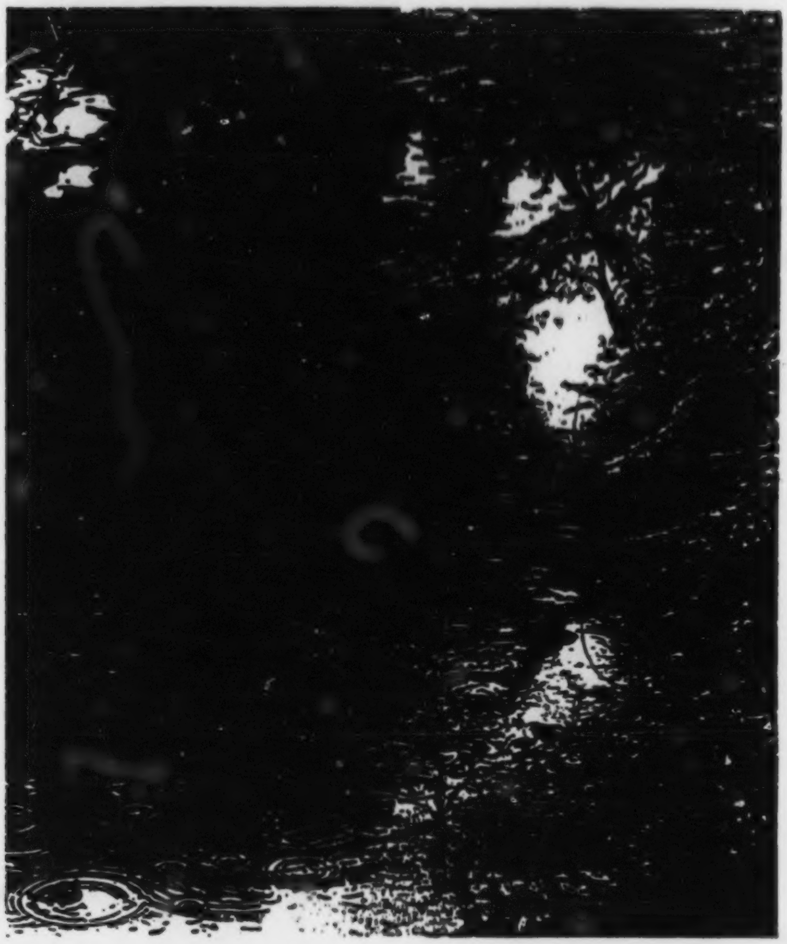

Like the ripples caused by raindrops in a pond.

constituting a dynamically balanced community subject to continual natural changes. For instance, a habitat with ample food plants for a large population of rabbits will in all likelihood also support such predators as foxes, coyotes, hawks, or owls, all of which enjoy meals of rabbits. Eliminate one species of the predators and the populations of the other animals will change. That might mean that there would be more rabbits, but, unless there are enough food plants to support the extra rabbits, some will die of starvation. More likely, the population of the other predators will increase and offset the rabbit surplus. In either case, a natural dynamic balance will be restored.

Enter the human animal into this habitat and it is probable that the natural balance will be drastically altered. A housing development, a school, and perhaps a shopping center would cause most of the predators to seek hunting territories elsewhere. The rabbits might remain, although their numbers would be greatly diminished by lack of food and protective cover, and by dogs and automobiles. Human changes would reverberate through the whole habitat, disrupting normal population fluctuation; new ranges of fluctuation would arise, perhaps only to be altered again by the effects of air and water pollution.

"Nature With Children of All Ages"
Edith A. Sisson
Massachusetts Audubon Society
Prentice-Hall, 1982

PEOPLE AND FORESTS

It would be hard to find a natural resource that's more useful than trees. We build with trees, make all kinds of products out of them, eat their fruit, and even extract energy from them. Trees provide more than just things for people to use, though. For example, trees keep soil from eroding and provide food and homes for wildlife. And forests provide recreation for people who enjoy camping, hiking, hunting, bird watching, and so on. Because they're so important in so many ways, trees and their habitats must be carefully managed. And that's where *forestry*—the science of managing forests—comes in.

FORESTS ON THE JOB

The idea of managing trees and forests didn't occur to early American settlers and pioneers. To them, the forests of the New World took up space that could be put to "better" use if it was farmed. So many forests were often cut down, burned over, and turned into pastures and cropland. By the mid-1800s, much of America's original forestland was gone.

But finally, in the early 1900s, the science of forestry began to catch on in the United States. (Several decades earlier, France, Germany, and other European countries had started to develop forest management techniques.) And today, managers put forestry practices to work on millions of acres of forestland.

A Forestful of Paper: Not all forests are managed in the same way, though. For example, a paper company may decide that it wants to grow as many *pulpwood trees* (trees that will one day be made into paper) as it can on a tract of land that it owns. So the company would manage exclusively for pulpwood. That may mean clearing the vegetation in the area, planting a particular species of fir, pine, or other fast-growing "paper tree," protecting the seedlings from insects and diseases, and thinning the growing stand to keep invading plants from competing with the paper trees for water and nutrients. Finally, after about 25 years, the pulpwood would be cut, or *harvested*, and made into paper. (See page 65 for a rundown on how paper is made.)

Putting Wildlife into the Picture: Another paper company, on the other hand, may decide that it wants to manage a tract of land not only for pulpwood but also for wildlife. Managing for wildlife might involve allowing the natural forest to stand in certain areas, putting up nesting boxes for birds and squirrels, and planting certain wildlife food plants.

Meeting the Needs of Many: In some forests, a lot of different factors are worked into the management plan. For example, one area in a forest may be managed for pulpwood and another may be managed for trees that could eventually be cut into boards and other building materials. The forest as a whole may be managed so that certain kinds of wildlife can live in it, and also so that people can camp in it, fish in its streams, and so on. This concept of managing a forest for several different uses at one time, called *multiple use management*, is practiced mainly in state and national forests (and to a lesser extent on commercially owned and privately owned forests). These forests belong to the public, and they have to be managed to satisfy the different needs of all the people who use them.

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FINDING A BALANCE

It's not always easy for forest managers to satisfy all the different demands people put on forests. Sometimes two or more forest uses will clash, and the conflicts that result can be difficult to resolve. Often these conflicts center on our ever-growing use of wood products and our desire, at the same time, to preserve forests for wildlife, recreation, and other things we value. Politics often play an important role too—especially in the management of public lands. Here is one example of the kinds of controversies forest managers face:

To Cut or Not to Cut: Forests in the United States rarely reach a "ripe old age" before they're harvested. That's because it's usually more profitable to harvest a forest after, say, 40 or 50 years than it is to wait 150 years or more for the trees in the forest to grow as large as they can. But here and there in the United States are parcels of *old-growth forest*—forests made up of very old, large trees. Some of these forests have never been logged; others may have been logged so long ago that the new trees that sprouted after the old ones were cut down have since grown old themselves. The reasons these forests were allowed to become old-growth stands vary. For example, in some forests the grade of the land makes it too steep for loggers and harvesting equipment to get to. Also, a few forests are so remote that hauling wood out of them would be more expensive than it's worth.

Today new innovations in equipment are making harvesting easier, and the increased demand for wood products is fueling the drive to open up old-gro[illegible] forests. (Old-growth stands in national parks and in designated wilderness ar[illegible] can't legally be harvested, although the parts of these stands that stretch outside park or wilderness boundaries are "fair game.") But many people think that only very limited logging—or no logging at all—should be allowed in old-growth forests. They are concerned that rare species of wildlife dependent on these forests could eventually become extinct as their old-growth habitats are harvested. Many scientists also feel that old-growth forests should be preserved because they can often support more species of wildlife than younger forests can. And some people feel that old-growth forests should be left intact as living monuments, since they're the last remnants of the huge, "untouched" forests that once stretched over much of the country.

WARDING OFF THE THREATS

Fire, diseases, and certain types of insects can really take a toll on forests, destroying millions of acres of forestland every year. That's why protecting forests from these threats is one of the most important aspects of a forest manager's job. Here's a rundown on each of these problems:

Burn, Baby, Burn: Forest fires account for tremendous losses in timber and other forest benefits. People are responsible for most of the fires (most are accidental, but some are deliberately set), and lightning starts the rest.

Forest fires aren't always bad, though. In fact, most forest managers now recognize that fire is a natural part of many forest communities. Lightning-caused fir[illegible] and other naturally occurring fires burn through some forests once every 25 ye[illegible] or so, and many trees in these forests benefit from the flames. In some pine forests, for example, a fire might destroy young hardwood trees that are becoming es-

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tablished in the forest's understory—but the pine trees might not be damaged much at all. (Many mature pine trees and some other trees have tough, fire-resistant bark.) Since pines are unable to compete with most hardwoods for sunlight, fire serves to maintain the pine forest by preventing hardwoods from "taking over" and becoming the dominant trees.

Some pines are adapted to fire by having cones that don't release their seeds until a fire passes through the forest. These cones have a gluelike resin that keeps them tightly shut. The heat of a fire melts the resin, allowing the cones to open up and drop their seeds. The ash left on the forest floor after a fire passes makes a nutrient-rich seedbed.

Blights and "Bugs": Since they're not as directly dangerous to humans as forest fires can be, diseases and insects that attack trees usually don't get as much publicity as fires do. Yet each year certain fungi, viruses, beetles, moths, and other threats together account for several times more forest damage than fire does.

Forest managers can fight these problems in several different ways. Often they use pesticides, fungicides, and other chemicals, but these can be damaging to wildlife and the ecology of the forest. So some forest managers try to keep diseases and insects in check with *biological controls*. For example, forest managers in an insect-infested area may try releasing sterile male insects. These males may breed with female insects, but any eggs the females lay will never hatch.

FORESTS FOR THE FUTURE?

Forestry is an intensive business in most of the industrialized countries of the world. That's because these countries can't afford *not* to manage a resource that provides so many benefits. Without management, forests and all the things we get from them would eventually be used up.

But in most developing countries forests aren't yet managed much at all. In fact, in many areas forests are viewed as obstacles to progress. As a result, forests in these countries are being cut down at an incredible rate. And because of the special soil and climatic conditions in these areas, the cleared forests often can't regenerate.

Much of this *deforestation* is occurring in the rain forests of the tropics. The reasons tropical rain forests are being cut down vary. A lot of tropical forestland is cut down by subsistence farmers, who farm the land for a couple of years and then are forced to move on after the land has lost its productivity. Huge tracts of rain forest are also cleared by cattle ranchers, who convert the land to pasture.

Scientists aren't sure what the environmental consequences of tropical deforestation will be, but many think that it could seriously affect the earth's climate. Others point out that, by destroying these forests, we're losing a huge potential source of medicines, foods, and other products that benefit people. And of course, when the rain forests go, the incredible diversity of plants and animals that they harbor will also be destroyed. (Scientists think there are thousands of rain forest plants and animals that we don't even know about yet.)

Obviously, ethical and sensible forestry practices need to be developed and implemented in rain forests. Without careful management, these forests could slip away before we even know what we've lost. (For more about tropical rain forests and the problem of deforestation, see the activity on page 52.)

Some scientists estimate that 1100 acres (440 ha) of tropical rain forest in South and Central America are cleared every hour. In the past century, the world's total acreage of tropical rain forest has been cut in half.

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The Problem: Global Warming

- The 1980s have produced the four hottest years of this century, and it looks like 1988 could make it five. The first five months of 1988 were so warm globally that 1988 will be the warmest year on record unless there is a remarkable, improbable cooling in the remainder of the year. (James E. Hansen, "The Greenhouse Effect: Impacts on Current Global Temperature and Regional Heat Waves," NASA statement to Senate Committee on Energy and Natural Resources, June, 1988)

- Present global temperatures are the highest since mankind has been keeping records. The rate of global warming in the past two decades is higher than at any earlier recorded time. (Hansen, 1988)

- The rate of average global warming is three times higher over the past 20 years than had been predicted by climatologists. (Hansen, 1988)

- Carbon dioxide (CO_2) in the atmosphere acts like the glass in a greenhouse. The sun's rays penetrate readily, hit the earth, and are reflected as longer-wave heat. Carbon dioxide bounces the heat waves back toward earth, trapping heat that would otherwise radiate into space. Other greenhouse gasses do likewise, but carbon dioxide is estimated to cause about half of the global warming phenomenon.

- World energy use is the main contributor to atmospheric CO_2. In 1987, the world's people burned enough fuel to release about 5.4 billion tons of carbon into the air -- 2 - 5 times the amount contributed by extensive clearing and burning of tropical forests. (Lester Brown, et. al., State of the World, 1988, Worldwatch Institute)

- Scientists estimate the level of atmospheric CO_2 could double in a relatively few years, if present trends continue. If that happens, average temperatures in portions of the United States could rise by 6 - 12 degrees Fahrenheit (3.3 - 6.6 degrees Celsius) in a matter of a few decades.

- The United States, with only one-twentieth of the world's population, produces nearly a quarter of the annual global CO_2 from burning fossil fuels.

- Urban areas with their expanses of concrete build up "heat islands" that are 3 - 5 degrees Celsius (5.4 - 9 degrees Fahrenheit) hotter than surrounding areas.

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GLOBAL RELEAF FACTS

One Solution. Trees and Forests

- Trees around homes and in communities are particularly valuable in addressing the carbon dioxide (CO_2) problem because of their effect in breaking up "heat islands" by shading buildings and concrete, and lowering peak energy needs for air conditioning. (H. Akbari, et al., "The Impact of Summer Heat Islands on Cooling Energy Consumption and CO_2 Emissions," University of California, Lawrence Berkeley Laboratory, July 12, 1988)

- A tree that provides shade and cooling indirectly causes reductions in CO_2 emissions equivalent to 15 times the amount of CO_2 the tree alone can absorb. (Akbari, et al., 1988)

- It costs about one cent to reduce peak-load energy demands one kilowatt-hour by planting trees. Similar savings from improving the efficiency of appliances would cost two cents and improving electrical supply efficiency would cost 10 cents. (Akbari, et al., 1988.)

- Reducing atmospheric CO_2 by one pound through tree planting costs about 0.3 to 1.3 cents; doing the same thing through improved appliances costs about 2.5 cents and realizing the same CO_2 reduction through more efficient cars costs 10 cents. (Akbari, et al., 1988)

- In America's urban forests, about four trees die or are removed for each new one planted. (Gary Moll, "The State of Our City Forests," AMERICAN FORESTS, 1987)

- Three well-placed trees around a house can cut home air conditioning energy needs by 10 - 50 percent. (Akbari, et al., 1988)

- Thrifty growing trees use CO_2 at the rate of about 48 pounds per year -- approximately 10 tons per acre per year. Put another way, for every ton of new wood that grows, about 1.47 tons of carbon dioxide are removed from the air and 1.07 tons of life-giving oxygen is produced.

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- There are economic opportunities (places where soils and climates are available to regenerate forests that would pay back at the rate of 4% per year or better) to increase timber growth in the United States by 17 billion cubic feet a year. (D. Hair, The American Forestry Association, unpub. ms., 1988) Achieving this new growth would reduce atmospheric CO_2 by 335 million tons, about one-quarter of what the United States is estimated to annually release from burning fossil fuels.

- There are an estimated 100 million available tree planting spaces around homes and businesses in United States towns and cities. Planting those trees could reduce atmospheric carbon dioxide emissions from energy production by an estimated 18 million tons per year. (Akbari, et. al., 1988)

- Planting those 100 million trees could save American consumers $4 billion each year in energy costs!

- The tropical zones are losing forest to agricultural conversion at the estimated rate of 27 - 28 million acres per year, an area equal to the size of Tennessee.

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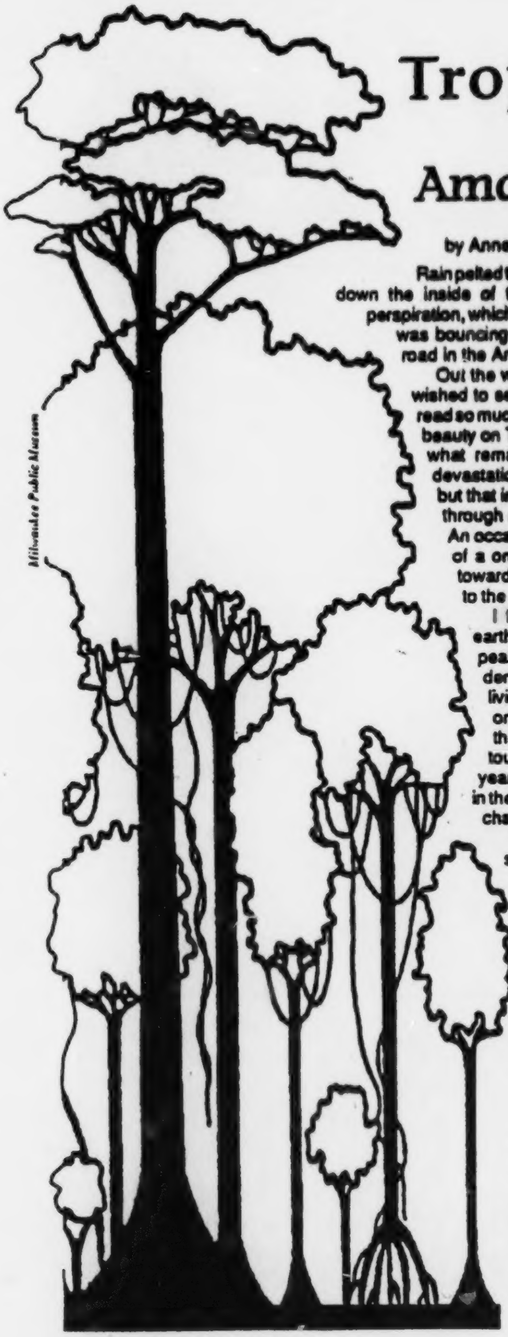
Tropical Rain Forests

Amazon



Milwaukee Public Museum

by Anne Hallowell

Rain pelted the outside, and moisture streamed down the inside of the window. I sat dripping with perspiration, which seemed only right. The bus I rode was bouncing its way down a rutted, red-mud road in the Amazon.

Out the window in the gray, steamy light, I wished to see the lush green of the forest I'd read so much about and seen depicted in all its beauty on TV documentaries. But I saw only what remained. I've never witnessed the devastation of a war-bombed landscape, but that image came to mind as we passed through mile after mile of scorched earth. An occasional charred spire, the remains of a once elegant rain forest tree, rose toward the sky. As if to add final comment to the decay, vultures often rested atop.

I felt an aching sadness. For the earth, for the life of the forest, for the peasants who had moved onto this denuded land in hopes of making a living, for my one-year-old son, asleep on my lap. When I was Henry's age, the Amazon was an uncharted, untouched wilderness. In a brief 30-odd years, my lifetime, a mere blink of time in the history of life on Earth, things had changed.

Tropical rain forests are under siege. Scientists are predicting that within the next 25 years, one-quarter of all biological diversity in the world—more than a million species—will likely vanish as forests are destroyed. Many species will be gone before they've even been discovered. No extinction of such magnitude has occurred since the extinction of the dinosaurs, 65 million years ago. A sobering thought.

Gazing out the window, I also couldn't help but wonder "Is this what northern Wisconsin looked like 120 years ago, after the great forests of white pine were felled and fires like the Peshtigo raged and ravaged the land? What must the Anishinabe, the Menominee, the Winnebago have thought? Were the hopes of last century's settlers who busted the prairie sod in Wisconsin the same as this century's settlers who fell the great forests of Amazonia?"

Uncanny parallels exist, warning us to refrain from too hastily being the pot that called the kettle black. Yet two wrongs don't make a right. Perhaps we've gained wisdom from our often erroneous ways, spurring us to act when we see others making similar mistakes?

Then I wondered about the fast fading future of our own country's rain forests—the temperate rain forests of the Pacific Northwest, the tropical rain forests of Hawaii and Puerto Rico. How much *have* we learned?

While the picture painted by statistics is grim, I remain hopeful. As Peter Raven, a renowned tropical forest scientist, is quick to point out, there *are* alternatives to the ax. He says, "People won't want to do anything if all you say is, 'Oh, isn't it awful about what's happening to the rain forests?'" There is much to be done, and much each of us can do.

...Seven hours later, we pulled into the village of Tomé-Açu. Its busy main street and market were a sensory delight for Henry and for his North American parents: pigs, tractors, logging trucks, noisy VW beetles, dogs, mud, pedestrians, transport trucks, chickens, and wagons created a colorful, confusing scene. This was the business center for a thriving community of farmers, immigrants from Japan, who during the past 60 years had developed a successful farming system in the surrounding forests of Amazonia. We had come all this way to visit one of the farms—to see and study the ecology of this example of sustainable agriculture in tropical forests (see article, pages 16-17).

It was inspiring to witness first-hand one of the many creative possibilities for using rain forests in less destructive ways. As we left Tomé-Açu and began the journey home, I felt more optimistic about the future of tropical forests—and more determined to do my little bit to help.

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"E E News," Vol. 7, No. 2
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About this issue...

This issue of *EE News* focuses on tropical rain forests. Why should we in Wisconsin care about forests so far away? Their loss affects us directly, and our actions affect their loss, as some of the following articles explain. Their loss is of global significance: it is impoverishing people, soil, the gene pool, and even our climate. Wisconsin is connected to the world economic community and the world environment. We can develop support for policies and programs that enhance life, health, species diversity, sustainable use of resources, and an attitude of stewardship towards the Earth.

We tend to think "Amazon" when we hear "rain forest," perhaps because we share the hemisphere with this great forest, and because it is, at two-thirds the size of the 48 contiguous U.S. states, the largest tropical forest in the world. However, tropical rain forests exist around the Equator: in Central and South America, the Caribbean, Africa, Madagascar, Southeast Asia and the Pacific islands (including Malaysia, Indonesia, and the Philippines), and Australia. The people, products, politics, and problems of these forests are as varied as the forests themselves.

The information and ideas in this *EE News* will provide, I hope, an interesting overview of the topic of tropical forests, plus a look at examples of specific forest-related problems and what's being done to address them. Also included are suggestions for what individuals can do, ideas for classroom activities, and resources for further information.

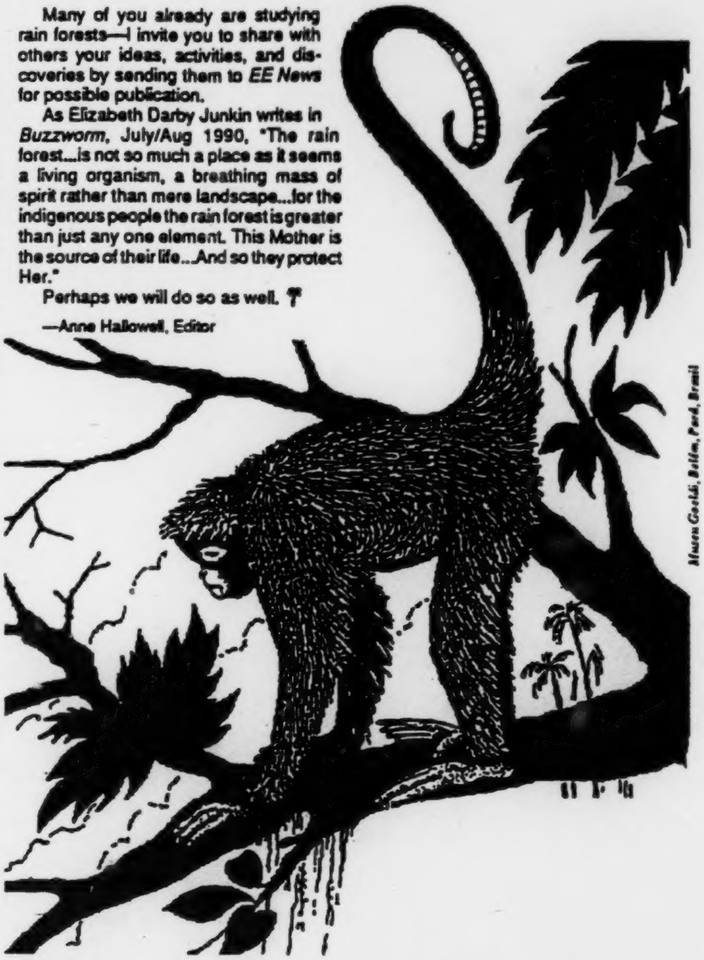
The subject of tropical forests is vast. I hope this *EE News* will serve as a jump-off point for you and your students, encouraging you to investigate, inspiring you to act.

Many of you already are studying rain forests—I invite you to share with others your ideas, activities, and discoveries by sending them to *EE News* for possible publication.

As Elizabeth Darby Junkin writes in *Buzzworm*, July/Aug 1990, "The rain forest...is not so much a place as it seems a living organism, a breathing mass of spirit rather than mere landscape...for the indigenous people the rain forest is greater than just any one element. This Mother is the source of their life...And so they protect Her."

Perhaps we will do so as well. ❦

—Anne Hallowell, Editor



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EE News is published quarterly and distributed to all Wisconsin schools (check with your principal), nature and environmental centers, Project WILD and Project Learning Tree educators, and WAEE members. Readers are encouraged to share *EE News* with other educators.

Contributions to help with the cost of printing and mailing *EE News* are welcome. Please make your check payable to "Education Programs, Wisconsin DNR" and send it to the address below.

The Editor invites articles, news items, resource suggestions, and letters to the editor for possible publication. Deadlines for submission are:

Spring issue—December 10
Summer issue—March 10
Autumn issue—June 10
Winter issue—September 10

Send to: Anne Hallowell, Editor, *EE News*, DNR Bureau of Information and Education, P.O. Box 7921, Madison, WI 53707, 608-267-5239.

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Anne Hallowell, Editor
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"E E News," Vol. 7, No. 2
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What Is the Rain Forest?

The rain forest Amazonia, the largest in the world, is multi-canopied, a luminescent green carpet with veins of silver, shining water in the morning light. It heaves a sigh and clouds form, hovering just beyond the tree tops. With its gentle, moist breath also flows an abundance for the world—boatloads of bananas and papayas, mysterious herbal medicines. For every malady is an answer in the forest, say its native inhabitants. It is not so much a place as it seems a living organism, a breathing mass of spirit rather than a mere landscape. —
Elizabeth Darby Junkin, in *Buzzworm*, July/Aug 1990

Where the equator crosses Latin America, Africa, and the archipelago that stretches from Southeast Asia to Australia, the sun shines with seasonless intensity. This is the realm of the tropical rain forest, a fascinating landscape that has evolved over millions of years.

In the course of human history, the tropical rain forest has sheltered indigenous peoples, challenged explorers, and inspired literature, art, and scientific research. Today, its extensive natural resources are being exploited at phenomenal rates for subsistence living and large-scale commercial ventures by an exploding human population. At current deforestation rates—estimated at 50 acres per minute—forests that took ages to develop will be decimated in the next 25 years.

Under a canopy of hundred-foot trees, the rain forest shelters half of all plant and animal species on earth—an exuberance of wildlife unlike anything we know in temperate climates. Thousands of plant species are found nowhere else; others, familiar to us, grow in oversized versions—violet plants the size of apple trees and 145-foot relatives of the common garden rose. Mammals, insects, and birds come in startling variations of colors and shapes, and challenge our preconceived notions of animal behavior. The unexpected rules in a place where fish eat fruit and snakes "fly."

Covering seven percent of the Earth's surface, rain forests contain *half* of all living species. "The wealth of biological diversity in this region is mind-boggling," writes Craig Thompson about Costa Rica in *Wisconsin Natural Resources* magazine. "Less than half the size of Wisconsin, the tiny Central American country of Costa Rica, for example, boasts 848 species of birds compared to Wisconsin's 306; 200 species of frogs to Wisconsin's 15; and 1,000 species of butterflies compared to Wisconsin's 150."

Yet logging, cattle ranching, and shifting cultivation are destroying the rain forest forever. In the long-run, these activities are not sustainable. Why? Because beneath the rain forest's fabulous richness usually lie soils that are surprisingly poor in nutrients.

The explanation for this paradox lies in the rain forest's great age. Most jungles descend from primeval forests dating from before the Ice Ages. These forests developed on ancient land surfaces with deep layers of well-weathered soil, leached of nutrients over time by rainfall. Over these poor soils, rain forests evolved into a highly efficient system, capturing nutrients in rainfall and rapidly recycling those in leaf litter and other decaying organic matter. Bacteria and fungi, which thrive in warm, moist conditions, decompose forest litter quickly, releasing nutrients that are rapidly taken up by a dense but shallow mat of plant roots. Very few nutrients are allowed to wash away or percolate into the soil.

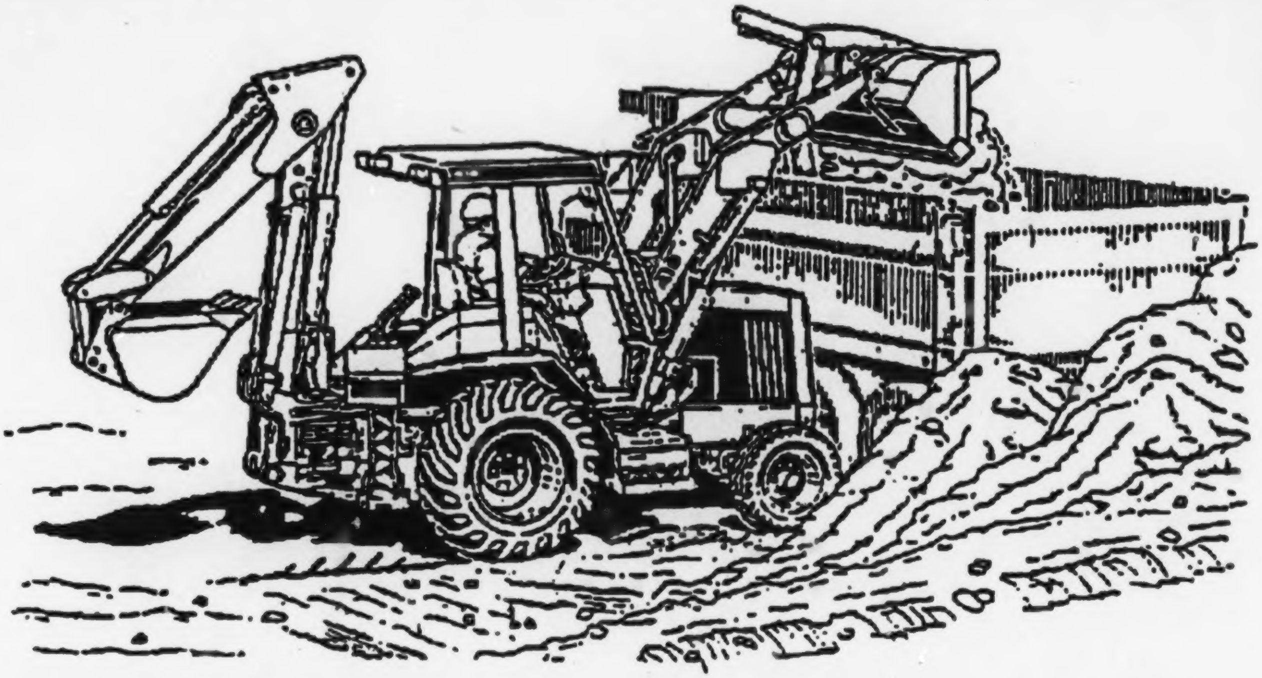
The rain forest's constantly hot, humid atmosphere makes these processes possible. Under a dense canopy that moderates the heat of the sun and slows the force of strong winds, temperatures do not vary much from 75-80 degrees year round. High humidity is generated by the profuse plant life, which returns much of the moisture from rainfall to the air through a process called transpiration. Transpiration of water vapor is so intense at night that scientists perched in the canopy have said it seems to rain *up*. In fact, scientists estimate that half the rain that falls on rain forests is created by the forest itself.

It's no wonder that rain forests have been called "castles built on sand." Most of the rain forest's nutrients are tied up within the luxuriant biomass and top few inches of soil. If the forest is cut and set on fire—a widespread agricultural practice—the initial enrichment from burned vegetation may support crops for a few years. But soon nutrients are washed away by the torrential rains, and little is left for continued farming. Lands are abandoned, but seldom does the rain forest return.

Can rain forests be saved? They *must* be. Much is being done, and much more needs doing. Sustainable uses of the rain forest already exist, scientists are studying forest ecology and how rain forests might be regenerated on degraded lands, and other creative and imperative approaches in education, politics, and economics are happening to help protect, preserve, and make wise use of these irreplaceable emerald forests. 𝕿

—From article by Pamela Cubberly in *Focus*, May/June 1988, Vol. 10, No. 3. Newsletter of World Wildlife Fund. Reprinted with permission.

Jack Shepherd



What Are the Causes of Tropical Deforestation?

The causes of tropical deforestation vary from region to region. In Latin America, forest clearing is a result of felling and burning to create small farms and cattle ranches, logging, or the opening up of areas for colonization and development projects such as mines or hydroelectric dams. Government officials hope that developing these vast areas will relieve overcrowding, supply food for hungry mouths, bring in needed foreign exchange, and improve their country's balance of payments. In Southeast Asia, logging and agricultural expansion are the main agents of loss. Large areas have also been cleared and replaced with plantations. In Africa, fuelwood cutting and small-scale agriculture seriously threaten forests.

Intact, these forests may represent even greater wealth for the people of the tropics. Yet until sustainable uses of the forest are widely implemented, the current trend of massive deforestation is not likely to stop. Let's look in more detail at the causes of deforestation:

Slash-and-Burn Agriculture

In many countries, particularly those in Latin America and some parts of Southeast Asia, a wealthy minority owns most of the fertile land. In Brazil, for example, 4.5% of landowners own 81% of farmland and 70% of rural families are landless.

Frequently the only land available for cultivation is in tropical forests, and governments have encouraged settlement of these regions by the landless poor. The land is usually ill-suited to the sort of agriculture practiced by settlers.

Slash-and-burn agriculture is a farming practice that worked when human populations were small. In earlier times, small plots of land were carved out of the forest and cultivated until the limited fertility of the soil was used up, usually in several years. The land was then left fallow and the forest allowed to regenerate before the cycle began again. Indigenous people who practice shifting agriculture tend to be highly skilled in this traditional practice.

But in the last 50 years, rapid population growth in the tropics has sent thousands of would-be farmers into the rain forest. They often lack knowledge of how to farm this type of land and after clearing larger plots, farm the land intensively. Nutrients in the soil decrease and crops soon fail. The only alternative is to move further into the forest, usually along roads built for logging. Environmental conditions on the abandoned land often have been changed so dramatically that forests can't regenerate. (See article pages 12-13.)

Up to 20 million acres of forest—nearly the size of West Virginia—are cleared each year in the tropics for agriculture. At least half of this new farmland is carved out of previously undisturbed forest. One can hardly criticize the actions of landless poor, however, who see slash-and-burn agriculture as their one hope for survival.

Logging and the Search for Fuelwood

In the tropics, rapid population growth has increased not only the pressure for agricultural land, but also the demand for fuelwood. Seventy percent of the developing world depends on wood for fuel. Poor people are compelled to destroy forests to cook food and heat their homes. Trees are also cut for building materials, fencing, and household implements.

Other logging operations seek the rain forest's hardwoods for export. Either an area is clearcut—the most destructive harvest method—or trees are cut selectively.

Selective cutting also causes severe damage to the forest, however. In contrast to traditional logging operations, which were highly selective and hand- or animal-powered (in places like Burma, for example, elephants were used to drag teak logs from the forest), contemporary loggers use chainsaws and bulldozers. A 1989 study in eastern Amazonia documented that in the process of removing four to eight trees per hectare (2.47 acres), 26% of all pre-harvest trees were killed or damaged, total canopy cover was reduced by almost one-half, and 8% of the forest area was scarred by roads. Such practices cause soil compaction, create conditions where fire is more likely to occur, and make erosion-prone logging tracks that open up the forest to settlers. Short-term profits from such operations can be lucrative for the landowner. But if logging in eastern Amazonia continues at its present rate, estimates show the region could be deforested within the next 80 years.

Then what? Many countries that have logged out their forests are facing the long-term realities of both a degraded environment and the need to import wood.

For the region in this study, strategies to promote the responsible use of the forest do exist; all that is lacking is the political will to bring them to life (see "Ecological Impacts of Selective Logging in the Brazilian Amazon" in "Articles" section of Resources).

Cattle Ranching

Cattle ranching is carried out on forest land cut and burned for the purpose or on land abandoned by slash-and-burn farmers. Millions of acres of rain forest, mostly in Central and South America, are converted to cattle pasture each year. For example, the municipality of Paragominas (27,000 km^2) in the Brazilian Amazon was almost entirely forested in 1960. By 1985, 24% of the municipality had been converted to pasture.

The nutrient-poor grasses that take hold once the rain forest is gone support few cattle, productivity declines after a few years, and land is often abandoned. These pasturelands are often left so degraded that they won't sustain agriculture and only scrub forest regeneration occurs.

Third World Debt

Many developing countries are burdened with huge international debts. During the 1970s and early 1980s—with the encouragement of industrial countries—developing countries borrowed enormous sums of money. Escalating interest rates and out-of-control inflation (for example, annual inflation has been about 1,500 percent in Brazil) forced debtor nations to take out further loans simply to meet their interest payments.

As a result, some developing nations allow logging companies to "mine" their forests in order to gain hard currency with which to make debt payments. Debt has also harmed tropical forests indirectly. In southern Brazil, for example, peasant families have been evicted from arable land which has then been used for the mechanized production of soybeans for export. Many of the evicted families have fled to Amazonia where they have had no alternative but to become subsistence farmers.

Aid and Development

Large multinational development agencies and banks have routinely funded development projects that harm tropical forest environments. Environmental components of project appraisal, implementation, and evaluation are often weak. And on occasion, it has been the donor country which seems to have benefited most. In one example, the donor country's aid funded the construction of logging roads through tropical forests. The forests were later exploited by that country's timber companies.

Numerous aid-funded projects involve replacing tropical forests with industrial plantations of eucalyptus, pine, and other fast-growing alien species, reducing the biological and ecological value of the land. As well, such projects have not always been successful generators of income.

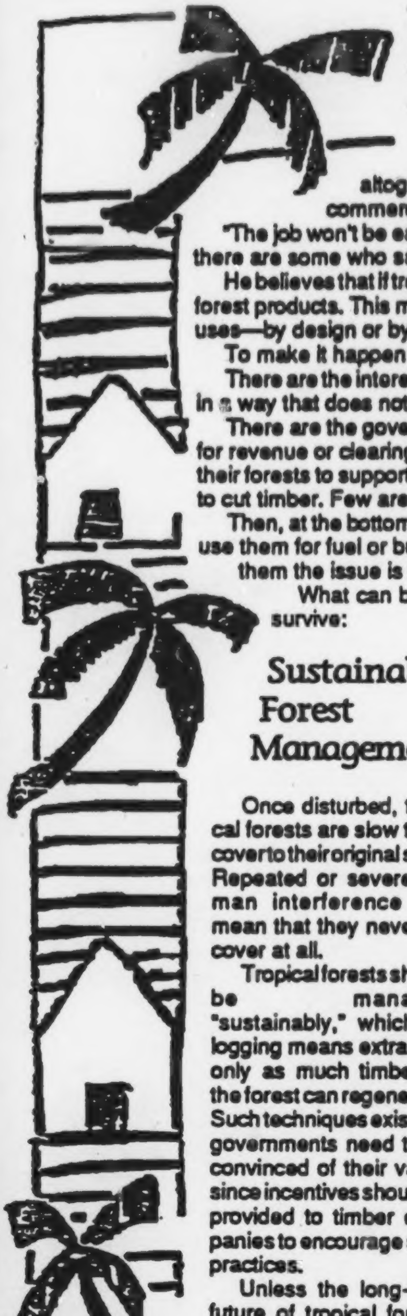
Aid grants are often linked to large-scale industrial projects meant to promote the industrial and social development of the recipient country. But frequently their potential environmental and social impacts are not fully assessed. The Gran Carajás project in the Brazilian Amazon, for example, may ultimately cause the deforestation of an area the size of France and the United Kingdom combined. The long-term impacts of this project have largely been ignored. Seldom are the people most likely to be affected negatively—indigenous people and/or local communities—consulted or considered in the plans.

—From: *Tropical Forests*, and article by Pamela Cubberly in *Focus*, May/June 1988, Vol. 10, No. 3. Publications of World Wildlife Fund. Reprinted with permission.

How Many?

Human Population Growth

1st billion:	2-5 million years	about 1800
2nd billion:	130 years	1930
3rd billion:	30 years	1960
4th billion:	15 years	1975
5th billion:	11 years	1986
6th billion (projected)	11 years	1997



Ensuring the Future of Tropical Forests

Tropical forest destruction could be considerably reduced, although probably not stopped altogether, given sufficient determination and effort on the part of governments, financial and commercial interests, and individuals.

"The job won't be easy," writes Richard Pardo in *American Forests* (Sept/Oct 1990), "and it won't come cheap, and there are some who say it can't be done. On the contrary: It *has* to be done."

He believes that if tropical forests are to be saved, it must be through sustainable production of a wide range of tropical forest products. This means that forests must be managed to produce tangible benefits, or the land will be put to other uses—by design or by default.

To make it happen will require strategies that reconcile interests at three political levels, he suggests.

There are the interests of the developed countries, who want a continued supply of tropical forest products produced in a way that does not contribute to global warming or destroy biologically rich ecosystems.

There are the governments of the tropical countries, many of which are deeply in debt and exploiting their forests for revenue or clearing them to export crops like beef, tea, rubber, or palm oil. These countries need to make use of their forests to support environmentally sound development but are in a dilemma: they are being paid good hard cash to cut timber. Few are offering to pay them a penny for *not* doing so.

Then, at the bottom of the ladder, are the estimated 250 million people who live in or near tropical forests and must use them for fuel or building materials, clear them to plant food, or exploit them for income to buy food and fuel. For them the issue is survival.

What can be done? Here are some reforms that, when implemented together, can help tropical forests survive:

Sustainable Forest Management

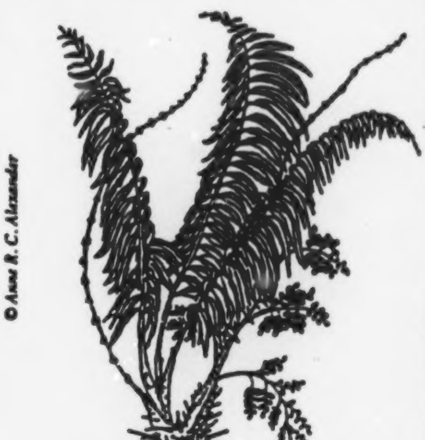
Once disturbed, tropical forests are slow to recover to their original state. Repeated or severe human interference can mean that they never recover at all.

Tropical forests should be managed "sustainably," which for logging means extracting only as much timber as the forest can regenerate. Such techniques exist, but governments need to be convinced of their value, since incentives should be provided to timber companies to encourage such practices.

Unless the long-term future of tropical forests can be assured, the international timber trade will die.

Non-timber Products

Indigenous peoples have demonstrated for centuries that tropical forests can yield far more than just wood. Non-timber forest products include berries, nuts, oil, rattan, fish, and game. Many of these cannot be grown on plantations, but can only be collected from the forest (see article page 18).



© Anne R. C. Alexander

rattan

Despite their significant long-term economic value, non-timber products are usually termed "minor" and little effort is devoted to their production or marketing. "Extractive reserves" are an attempt to change this (see article page 19).

Although extracting non-timber products is a way of both maintaining forests and providing employment and income, political effort is needed to make it more of a reality. It is so much easier for governments to offer logging concessions than to organize an extractive reserve for the long-term benefit of local people.

Reforestation

Reforestation cannot return logged-over or cleared forest to its original state in less than centuries. Neither can it bring back the genetic resources lost when original forest is removed. But it can reproduce some of the environmental functions of the original forest and provide fuelwood, which reduces pressure on remaining forest. Reforestation could also play a crucial role in ameliorating the impacts of the greenhouse effect.

Hank Drennan

Deforestation continues at a far greater rate than reforestation. For every 10 hectares (25 acres) cleared, less than one hectare (2.47 acres) is replanted. Replanting on degraded land also requires significant amounts of fertilizer and human energy.

On small areas in disturbed forests or surrounding areas, agroforestry (tree and crop interplanting) should be encouraged (see article, pages 16-17).

Tapir Tracks, newsletter of Monteverde Conservation League

Producer Country Legislation

Some countries are introducing legislation to prevent further tropical forest destruction. For example, by allowing the export of only processed wood, which is of higher value, a producer country earns more than if it exports raw logs. Under such a system, the forests gain in economic value, which hopefully leads to a greater desire to use them sustainably. Other countries are completely banning logging in their remaining primary forests.

Fairer distribution of land would also relieve human pressure on forests. Often a wealthy minority owns the most fertile agricultural land and the landless poor are forced to clear forests in order to survive.

Removing tax incentives for cutting forests is also a step in the right direction. Brazil, for example, has suspended incentives for cattle ranching in dense forest areas.

The Greening of Aid

Greater planning must occur to ensure that aid-funded projects such as road and dam construction, tree crop plantations, and agricultural settlements are at least sited away from intact forests and key watersheds or ecosystems.

Greater account must be taken of the needs of those local or indigenous people affected by the projects.

Successful development projects are rare, and economically and environmentally harmful projects continue to be funded. Citizen pressure has often assisted in encouraging multinational banks and developed nation's governments to reconsider funding development programs because of detrimental effects on environment and people (see article, page 22).

Perhaps more important, aid support should be shifted from large-scale capital intensive projects to smaller projects that involve sustainable management of natural resources.

Debt-for-Nature Swaps

One of the most creative programs yet for saving tropical forests is "debt-for-nature swaps." These swaps offer debtor nations a means to convert portions of their foreign debt burden into support for conservation.

For example, a conservation organization might purchase$2 million worth of debt for $450,000—a discounted amount agreed upon and paid to the international lending bank that the country owes. The bank then forgives that debt. Prior to the purchase, the country has come to an agreement with the conservation organization to, for example, establish a national park or nature preserve in exchange for the purchased debt. The result is that the country writes off some debt, the international bank receives cash (for debt that was unlikely to be paid at all), and a portion of tropical forest is preserved.

While funds from such swaps are often used to preserve a forest, this alone is often not enough to protect it. Laws must be enforced and local people educated to understand the preserve's importance and to help support its existence (see article, page 15). As well, problems may arise when land set aside has been home to indigenous people, who now find their land taken away in the name of conservation. Debt-for-nature swaps are increasingly involving indigenous populations in the planning phases.

Education and Training

A key to the success of any conservation or forest management program is local citizen understanding and the presence of trained nationals who can do the job themselves. A major element of many conservation programs worldwide is environmental education and professional training. 🌴

—Compiled from: "Pardo's Law for Saving Tropical Forests," *American Forests*, Sept/Oct 1990; *Tropical Forests*, World Wildlife Fund. Reprinted with permission.

What Can You Do?

Tropical forests are going to be saved when we take local actions that support global sustainability. These actions must happen in tropical forest countries and in our own country.

Everyone can help protect the world's rain forests. Here are some ways you can get involved in saving them:

Become better informed. If you are interested in a specific animal, part of the world, or rain forest issue, look into it. For example, find out what roles our government, major lending institutions, businesses, and consumer habits are playing in projects or actions that harm tropical forests. Your librarian can recommend books and periodicals. Watch television programs on the subject. Invite speakers to your classroom or organization.

Share your views. Make your views known by talking with others and writing letters to your congressional representatives, the editor of your local newspaper, and corporate executives. Your informed commentary can influence those in power and promote public debate.

Join a conservation group. There are many organizations—local, national, and international—working on a wide variety of conservation issues. By joining one, you can learn what needs to be done and how you can help. See "Organizations" in the Resources section of *EE News*.

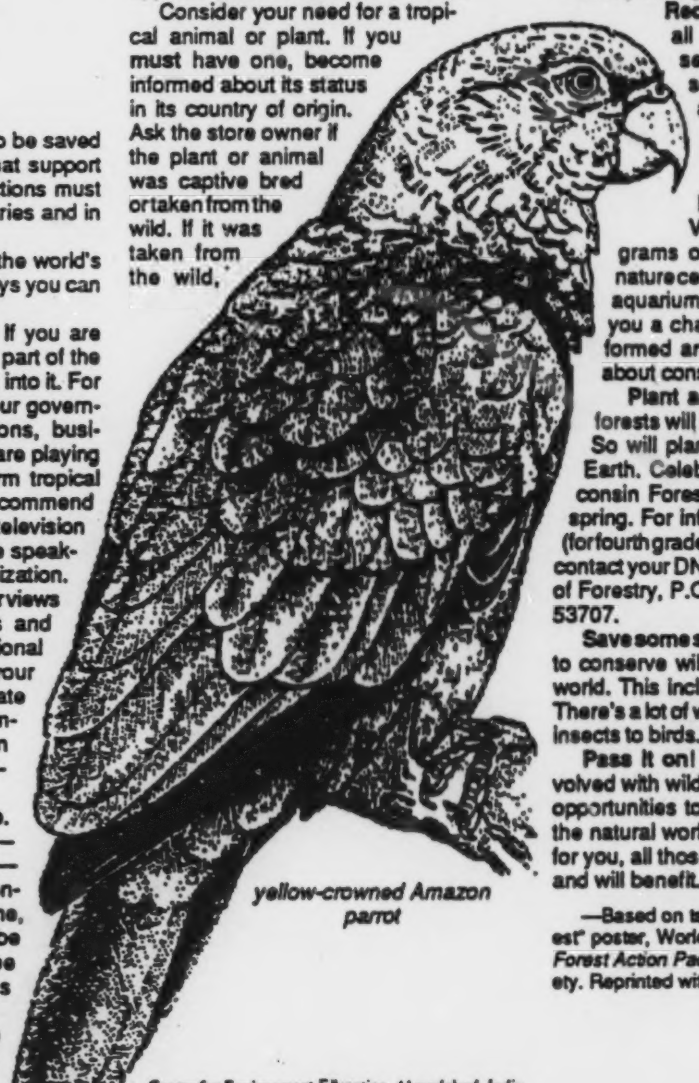
Establish a partnership with another country. To encourage cultural and environmental understanding and exchange, consider entering into a "sister school" or "sister city" relationship with people in a tropical country. Such a relationship can enrich everyone.

Think globally. Encourage your school or youth group, your local or national conservation organization, or other groups you're involved with to take a global view of rain forest problems. Groups in the United States can help save rain forests in our country and beyond.

Don't buy animals or plants taken illegally from the wild. Fueled by the developed world's demand for luxury items, curios, and exotic pets and plants, illegal trade is removing life from remaining rain forests. Even areas set aside as national parks and reserves are losing integral plant and animal species to the international appetite for the exotic and unusual.

Consider your need for a tropical animal or plant. If you must have one, become informed about its status in its country of origin. Ask the store owner if the plant or animal was captive bred or taken from the wild. If it was taken from the wild, ask the owner whether he or she is sure it can be legally sold. Unless you ask questions, illegal trade will not decline.

If the object is a tropical plant or animal product (e.g., teak, mahogany, ivory [which is now illegal to import into the United States]) investigate the legality of the item and the impacts your purchase may have on the environment and people of the country of origin.



yellow-crowned Amazon parrot

Centre for Environment Education, Ahmedabad, India

Recycle. Support recycling of all reusable materials. Conserve fuel and energy resources. By taking a creative look at your home and workplace, you can make some changes that will lead to more sustainable lifestyles.

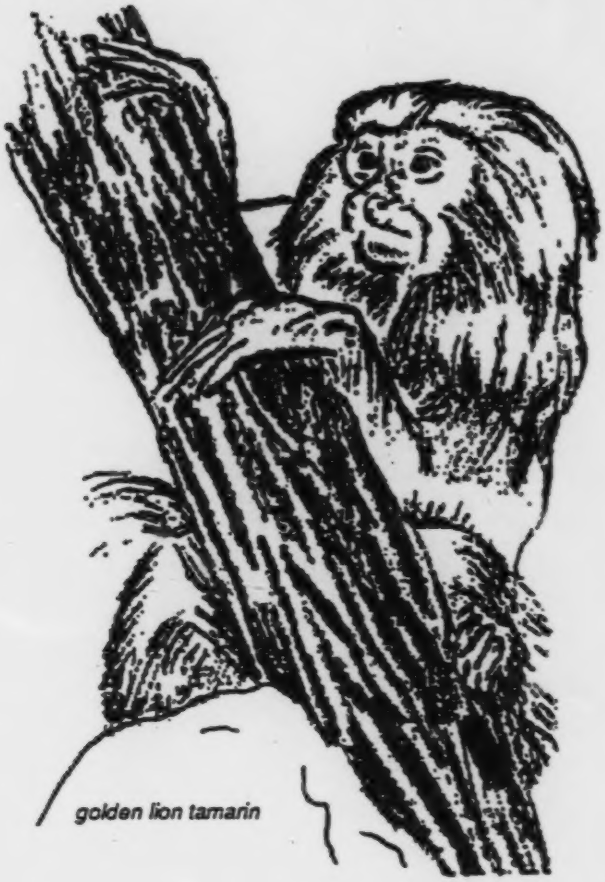
Volunteer. Join the programs offered through your local nature center, botanical garden, zoo, aquarium, or museum. They will give you a chance to become better informed and to help educate others about conservation issues.

Plant a tree. Halting loss of rain forests will help slow global warming. So will planting a tree anywhere on Earth. Celebrate Arbor Day and Wisconsin Forest Appreciation Week this spring. For information about free trees (for fourth grade classes) and other events, contact your DNR forester or DNR Bureau of Forestry, P.O. Box 7921, Madison, WI 53707.

Save some space for wildlife. The fight to conserve wildlife goes on all over the world. This includes your own backyard. There's a lot of wildlife there, from plants to insects to birds. Encourage and protect it!

Pass it on! Once you've become involved with wildlife, you will have endless opportunities to tell others. If conserving the natural world becomes a high priority for you, all those around you will notice—and will benefit. 🌲

—Based on text from: "Save the Rain Forest" poster, World Wildlife Fund; and *Tropical Forest Action Packet*, National Audubon Society. Reprinted with permission.



golden lion tamarin

Barry Carlsen

Newsflash

House Joint Resolution 431 was passed September 17, 1990 in the House of Representatives. The resolution will establish a U.S. policy to encourage and support Brazilian efforts to save the Amazon rain forest. It also calls upon the United States to redouble its efforts to reduce its own pollution of the world's environment.

"It simply makes no sense to spend U.S. taxpayers' money on foreign aid projects which destroy the environment," said Congressman Toby Roth, R-WI.

Roth said the resolution sends an important message that the U.S. and Brazil should increase their efforts at conserving the rain forest. "We must be vigilant and judicious regarding our involvement in projects which place additional pressure on the Amazon rain forest," said Roth.

Roth said the tremendous abundance of diverse plant and animal species in the Amazon must be preserved. "We should all remember that we haven't inherited the Earth from our parents, we're merely borrowing it from our children." ₸

...Given the choice of repairing your house or having it collapse around you, you would not question whether to undertake the project.—State of the World 1990

Why Bother...

Why bother with golden lion tamarins or rosy periwinkles? Staring out at the wing of an airplane in which he was flying, renowned conservation biologist Paul Ehrlich noticed thousands of rivets fastening the wing together. The loss of a rivet here and there might not lead to the structural collapse of the wing immediately, but keep removing rivets and, at some point, the entire wing would disintegrate.

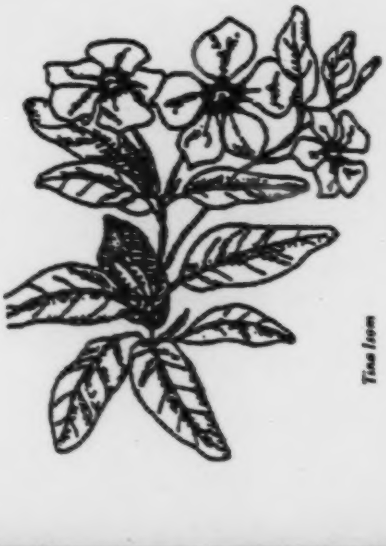
Analogously, he reasoned, loss of a species here and there might cause no irreparable harm to planet Earth, but the rapid loss of species resulting from human destruction of natural habitats is clearly a fast track to biological collapse.

Although species extinction is a natural phenomenon, human activity has accelerated extinction rates to 1,000 times faster than normal. While the scientific community recognizes this process as a tragedy in the making, the consequences often are visible only incrementally, and the extinction problem thus seems a less catastrophic threat than nuclear war, for example.

Nevertheless, eminent Harvard biologist E.O. Wilson writes: "If no country pulls the trigger in a nuclear war, the worst thing that will probably happen—in fact is already well underway—is not energy depletion, economic collapse, conventional war, or even the expansion of totalitarian governments. As tragic as these catastrophes would be for us, they can be repaired within a few generations. The one process now going on, that will take millions of years to correct, is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are the least likely to forgive us." ₸

—From: *Montana Outdoors*, May/June 1988.

Rosy periwinkles from Madagascar contain several chemicals that are used to make medicines for treating leukemia.



Tina Isom

Is Managing Rain Forests Up To Us?

Calls to "Save the Rain Forests" have stirred as much or more global concern than campaigns to "Save the Whales" a decade ago. And for good reason.

Many experts believe the logging and burning of Amazonia's tropical forests could affect weather patterns around the globe. Numerous plant and animal species unique to the region—some with undiscovered pharmaceutical potential—are threatened with extinction. So are some of the region's tribal peoples.

"Brazilian Amazonia is Amazonian *Brazil*, part of Brazil's national territory," UW-Madison rural sociologist Archibald O. Haller points out. "It will be Brazilians, not *estrangeiros* who will make the decisions that will determine the nature of the region."

In fact, Brazil has responded defiantly to North American's concern about the destruction of the Amazon. Brazilian officials tell them to read U.S. history.

"They say, 'You cut down your forests and even killed your Indians to develop your country,'" one scientist said. "They say, 'You have gotten where you are today as a nation because of it. Now you have the goodies and you want to keep us from getting ours. You want to keep us down."

Concern among developed countries that removal and burning of forests in the Amazon is contributing significantly to the greenhouse effect is countered by Brazilians, who point out that industrialized nations burn, per capita, more than 90 percent of the world's fossil fuels.

As reported in the *Chicago Tribune*, the worldwide campaign to save the Amazon has touched a raw nerve in Brazil and sparked a nationalistic backlash. Staggering under the burden of its $115 billion foreign debt and widespread poverty, a defiant Brazil is determined to proceed on its own course despite the outcry from the world's rich industrialized nations for an end to the tree burning, cattle ranching, mining, and industrial development that is scarring the Amazon.

Proposed debt-for-nature swaps, for example, are viewed derisively by Brazilian government officials as an "internationalization" of the Amazon, a worldwide movement they regard as tantamount to demanding that Brazil sell away control of the largest, potentially richest portion of its national territory.

Brazilian officials say they are open to cooperation with foreign scientists and unconditional aid from abroad for preserving the rain forests. But one way or another, they insist, the Amazon will be developed.

Haller suggests that foreign scientists should make their expertise available to Brazilian policymakers, but shouldn't preach. They must recognize the many social and political factors involved.

For Brazilians, the Amazon is a complex and emotional matter that touches directly on their sense of national identity. Brazilians have been taught since childhood that the Amazon ensures that the future belongs to Brazil and that foreigners, going back to 17th century Portuguese and Spanish gold prospectors, have been trying to steal it away.

A nation of 150 million people in a land almost as large as the continental United States, Brazil, too, claims a manifest destiny to tame its wild frontiers, tap its vast resources, and develop into a major world power.

Brazil has the world's eighth-largest economy, but also is the developing world's largest debtor nation, with a swelling population of perhaps 80 million hard-core have-nots. The landless poor have heeded the nation's 1970s call to settle the Amazon, "a land of no men for men with no land."

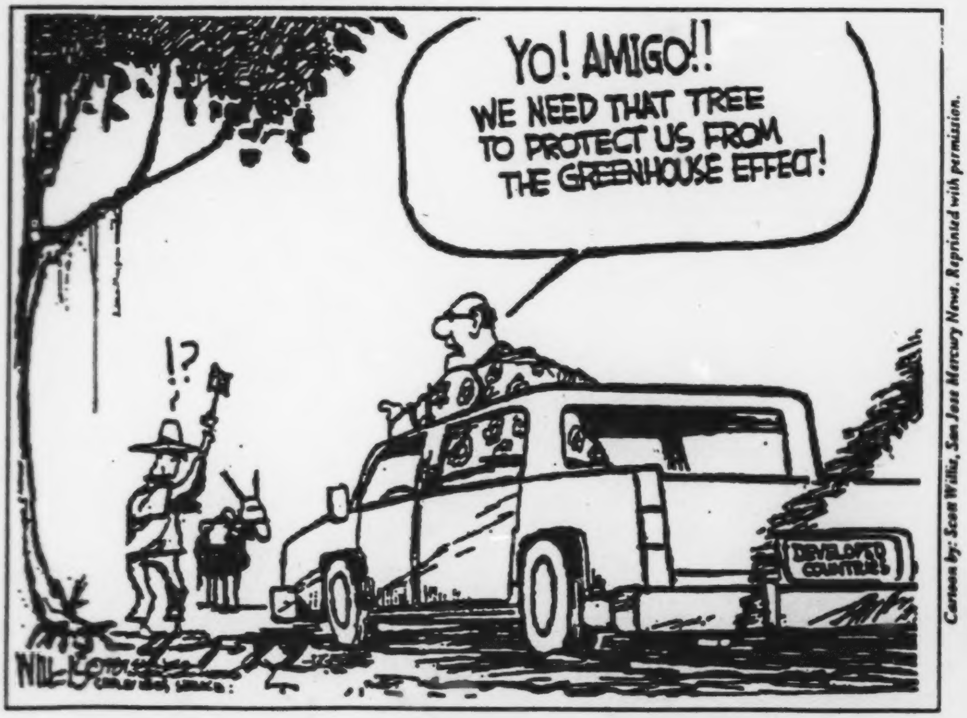
"Poverty is the chief environmental problem," said Paulo Nogueira-Neto, ecology professor at the University of Saõ Paulo. "If people had good jobs in the cities, they would not go to Amazonia. Relief from our foreign debt would help quite a bit with the Amazon."

But Brazilians are realizing that preventing the widespread destruction of the Amazon is in Brazil's own long-term interests. And slowly, Brazilians are coming around to the view that they cannot do it alone.

Worldwide reaction has not stopped the destruction, but it has strengthened the position of environmentally responsible Brazilians, including many working for the government.

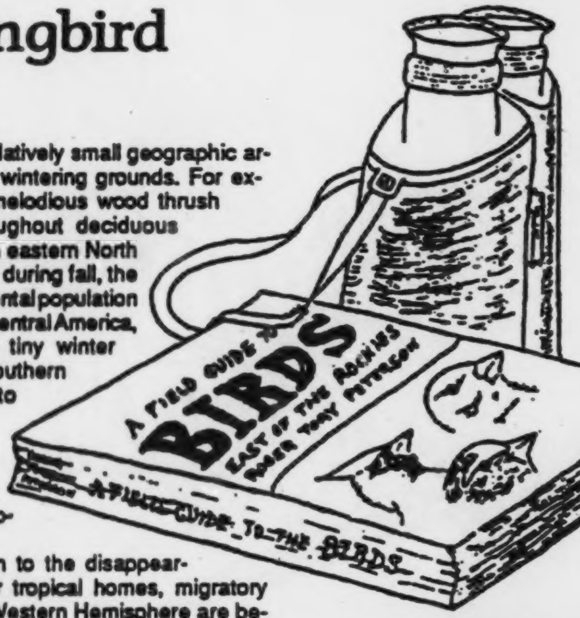
"The international outcry helped very much," said Nogueria-Neto. "It made people aware of the problems, both inside and outside Brazil. Now we have to do something to take care of it." ₸

From: "Managing Rain Forests Isn't Up To Us," Paola Scommegna, *The Quarterly*, Spring 1990, Vol. 9, No. 1, publication of UW-Madison College of Agricultural and Life Sciences; and "Defiant Brazil," George de Lama, of the *Chicago Tribune*, in *Wisconsin State Journal*, March 19, 1989.


YO! AMIGO!!
WE NEED THAT TREE TO PROTECT US FROM THE GREENHOUSE EFFECT!
!?
DEVELOPED COUNTRIES
WILLIS

Cartoon by: Scott Willis, San Jose Mercury News. Reprinted with permission.

"Our" Birds? The Songbird Connection



"The spring may not yet be silent, as Rachel Carson warned a quarter of a century ago, but even casual bird-watchers have noticed that it has been much quieter lately," reports an article in *U.S. News & World Report*, August 7, 1989.

Migratory songbirds are sending us a dramatic message about the destruction of tropical forests in the Western Hemisphere. We are seeing and hearing them less and less. Although pesticides and urbanization have diminished nesting populations here, bird numbers are dropping alarmingly with the loss of their primary habitat—tropical forests.

More than three-quarters of all species of North American birds are migratory and winter in the tropical forests of Mexico, Central America, the Caribbean Islands, and South America. Among them: 47 of the 52 warblers (ovenbird, American redstart, and Wilson's, Northern parula, hooded, and black-and-white warblers), 22 of the 32 flycatchers (Eastern kingbird, Eastern and Western wood pewees, and vermilion, scissor-tailed, and olive-sided flycatchers), nine of the 11 vireos, and all four of the tanagers. Of the thrushes, loveliest of the woodland singers, four of the five—the wood, gray-cheeked, and Swainson's thrushes, and the veery—all winter in the tropics.

Among the non-singing migratory birds are 14 of 15 hummingbirds, all four swifts, Swainson's hawk, broad-winged hawk, swallow-tailed kite, and Mississippi kite.

"Our" migratory birds are actually oriented more to the tropics than to temperate forests. They spend six or seven months each year in their tropical habitat, feeding on insects. Having gained the necessary fat, they fly north in our spring. It is a hazardous journey which many do not survive; it may require four to six weeks each way, with resting stops. A few species, however, do it in a single, exhausting flight. During the three or four months the birds spend in temperate-zone woodlands, they breed, nest, fledge their young, and prepare to fly south again.

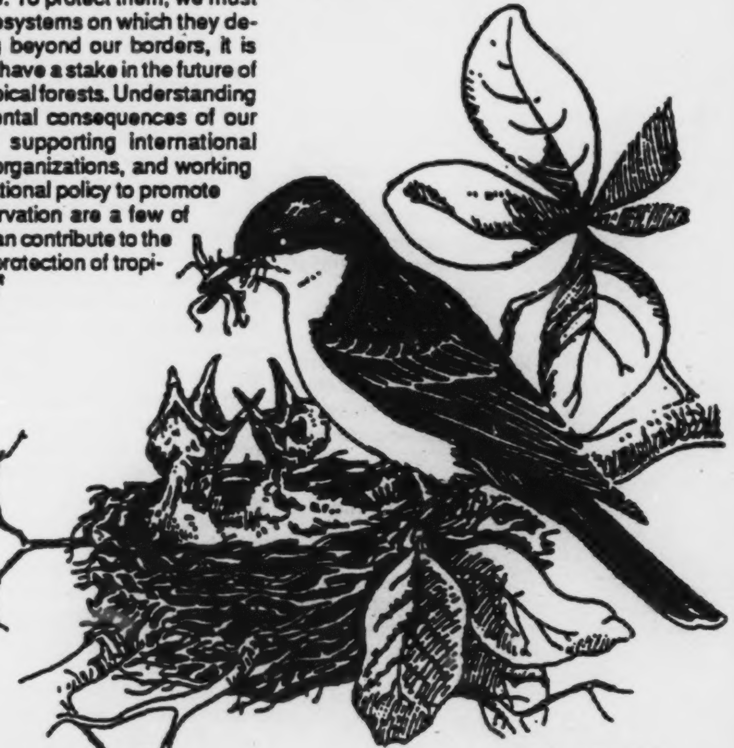
Many migratory birds return to the same places each year. Increasingly, they are arriving in the tropics to find their forest homes burned or bulldozed away. They then must fly on in a weakened condition, often dying along the way.

The disappearance of the tropical forests of Central America is especially serious for "our" songbirds. Research on their distribution reveals that many species pack tightly into relatively small geographic areas on their wintering grounds. For example, the melodious wood thrush breeds throughout deciduous woodlands in eastern North America. But during fall, the entire continental population funnels into Central America, occupying a tiny winter range from southern Mexico to southern Panama. As the forests go, so do their inhabitants.

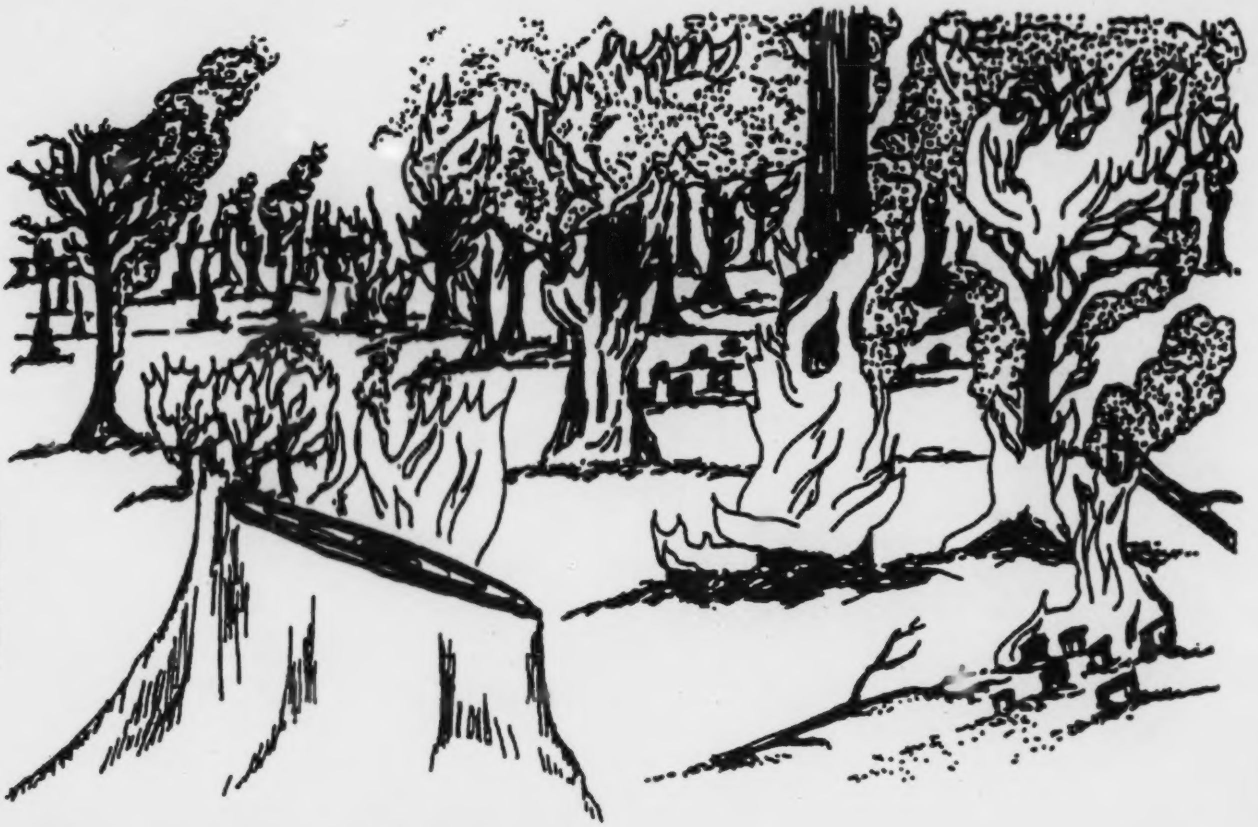
In addition to the disappearance of their tropical homes, migratory birds of the Western Hemisphere are being stressed on their nesting grounds in the temperate forests of North America. These forests are being destroyed by development or fragmented by roads and building projects. Urbanization makes bird nests more vulnerable to predators tolerant of humans, like raccoons, skunks, and cats.

Migratory birds are a shared international resource. To protect them, we must protect the ecosystems on which they depend. Looking beyond our borders, it is obvious we all have a stake in the future of the world's tropical forests. Understanding the environmental consequences of our consumption, supporting international conservation organizations, and working for a strong national policy to promote tropical conservation are a few of the ways we can contribute to the wise use and protection of tropical habitats. ♈

—From: "Tropical Deforestation: Why Is It Happening?," a poster from *American Forests* magazine (for a copy, send $1.25 to: American Forests magazine, American Forestry Association, P.O. Box 2000, Washington, DC 20013); and "Trouble Beyond Our Borders," by Craig Thompson, in *Wisconsin Natural Resources* magazine, April 1989, Vol. 13, No. 2. Reprinted with permission.



Eastern kingbird



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Ashes in the Amazon

by Carol Savonen

"Imagine the forests of the Cascades of Oregon and Washington, the Siskiyous, the Coast Range, and the Olympics, all burning in one year. That's roughly the equivalent to the amount of land that burned in only one year in the Brazilian Amazon," said J. Boone Kauffman, a fire ecologist at Oregon State University.

Deforestation has become a global issue. Large-scale loss of tropical forests by logging, slashing, and burning not only destroys unknown numbers and varieties of plants and animals, it may be changing our planet's entire atmosphere, climate, and ecology.

An area of Brazilian forest twice the size of California has already been burned. Yet little is known about the effects of fire on tropical forests. Did tropical rain forests naturally burn? What happens when large tracts of land are cut and burned? How likely are areas to burn after selective logging? Will the forest regenerate? Which plant species tolerate fire? Which can't? What can be done to help restore the health of the land while supporting the expanding human population?

Questions like these are driving researchers like Kauffman to investigate the effects of fire in tropical forests.

"We are witnessing a grand experiment in Amazonia," said Kauffman, "forcing us to ask 'how much disruption can the ecosystem take before things are irreparably damaged?'"

Amazon rain forests have always been subject to sporadic and patchy natural disturbances, explains Kauffman. Floods, windstorms, and fires have swept through the Amazon Basin for millions of years. And for several thousand years, humans have cleared small areas and set fires to prepare land for hunting and slash-and-burn subsistence agriculture.

Today, however, pressures on rain forests are escalating and deforestation is widespread. Whenever a forest canopy is opened, whether by slash-and-burn agriculture, timber harvest, or cutting for cattle pasture, the understory environment changes and the forest can no longer sustain itself.

"One of our questions was, 'Can fire occur in intact wet tropical rain forest?'" explained Kauffman. "In fact, [our research shows] that it's almost impossible."

Once the forest has been even partially cleared or logged, however, conditions change dramatically. Cutting exposes the forest floor to sun and leaves large accumulations of woody debris on the forest floor. Temperatures soar, causing fuels to dry and become extremely flammable.

"Once an area has been disturbed even by partial timber harvest, it's not a matter of will the area burn, but rather when will it burn," said Kauffman. "It is inevitable."

There is nothing so dramatic as seeing the results of a tropical forest fire, he said. "Many times, there's nothing left but ash and charred black stumps."

People have so altered the environmental conditions in deforested areas of the Amazon, Kauffman said, the ecosystems are "unraveling" and irrevocably changing.

An intact rain forest creates its own climate—scientists estimate about one-half of all the rainfall originates from the moisture given off (transpired) by the forest itself. When large tracts of land are deforested, local and overall climatic patterns may change. Once the forest is gone, drought may occur, intensifying the probability of fire and decreasing the probability the forest will ever return.

Even more dramatic perhaps is the impact of forest fires on global climate. Through the process of photosynthesis, trees take CO_2 from the air and use the carbon to form wood (wood is about 45% carbon). When trees are cut down, the carbon they've stored is released—at a slow pace if the tree decays naturally, and instantly if the tree burns. Thus, burning of cut forests can contribute to global warming in two ways: 1) burning of clear-cut trees releases CO_2 (the major greenhouse gas), and 2) those trees are no longer available to absorb CO_2. Based on weather satellite photographs, scientists estimated "conservatively" that 51 million acres of Amazonia burned in 1987. Of this, 20 million acres was virgin forest land. All told, fires released 620 million tons of carbon gases into the atmosphere.

Very few Amazon plant species are adapted to fire, noted Kauffman. Because fires were extremely infrequent through the ages, most Amazon plants never developed strategies for dealing with the severe environmental stress of a fire and the post-burn environment.

Kauffman and his colleagues are studying which plant species survive after being burned. By seeing which are the most and least tolerant to fire, they will be able to determine what kinds of land use activities are sustainable and how damaged ecosystems might be restored.

About the results so far, says Kauffman, "We got dramatic losses of species in these burned areas."

Estimates vary widely about the rate of deforestation and burning of the world's tropical forests, but one thing is clear—species are being lost at an alarming rate. Whole communities of unique plants and animals are disappearing within a few decades, less than the lifespan of many of the forests' human inhabitants.

"We certainly have learned that all is not well in the Amazon," Kauffman said.

To save what remains of the world's tropical forests, scientists realize that successful strategies will have to consider more than simple preservation.

"It is very obvious that rampant deforestation is not a biological problem. It's merely a reflection of social problems with multiple causes," said Kauffman.

Robert Buckman, a professor of forest resources management at OSU, expands on that.

"If we have to address environmental problems and topics, we must concurrently address social and economic needs," said Buckman. "A combination of acute poverty, population explosions, serious health problems, a legacy of colonialism and lack of infrastructure in government, endemic and epidemic corruption, a history of absolute government, and a lack of training and education are all causal."

Kauffman and Buckman agree there is no quick fix for the overwhelmingly complex problem of tropical deforestation.

"It's the policy people who are coming up with the answers—for example, economists are finding that a tropical forest is worth more standing than logged. Brazil nuts, rubber, wildlife, and other food products coming from one acre of forest are worth much more than a lumber or pasture value of the same land over the long term." (See article, page 18.)

Other suggested strategies include population control through education and renegotiation of foreign debts to allow debtor nations to swap intact forest land for debt.

Moving toward a market economy might also provide incentive to leave the forest standing, said Buckman.

There are more tangible approaches as well. Agroforestry, the practice of growing food-producing trees and shrubs in crop fields on deforested lands, has shown potential for increasing the productivity of cleared land (see article, pages 16-17).

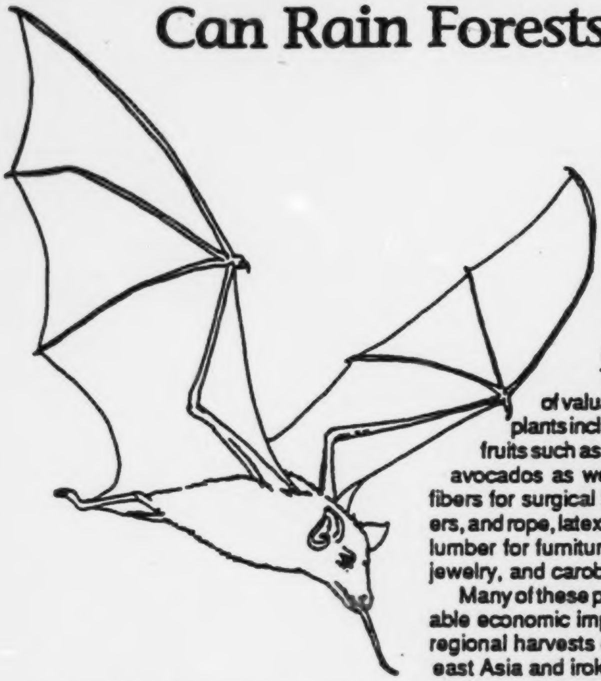
"All these solutions are important," said Kauffman. "We need to remember that what affects these people also will affect us here in the United States."

Scientists are now saying global warming will occur, or may be already occurring, because of the losses of tropical and temperate forests, a major source of carbon storage.

"But what we're doing down there is helping to understand a very important global system. Everything is connected. We have a tremendous obligation to help impoverished people of the world to try and save valuable ecosystems and save our planet."

—Condensed from: *Oregon's Agricultural Progress*, magazine of the Oregon State University Agricultural Experiment Station, Corvallis, OR. Reprinted with permission.

Can Rain Forests Survive Without Bats?



by Merlin D. Tuttle, Science Director, Bat Conservation International

Loss of rain forests is one of our most serious environmental problems. Major conservation strategies already are being planned. Yet few, if any, decision makers understand the extent to which these forests depend on bats for their survival.

In tropical ecosystems, bats often comprise more than half of all mammal species, and their biomass may in some places equal that of all other mammals combined. Nevertheless, most species have never been studied, and major ecosystem studies have failed to acknowledge that bats even exist. Such neglect can have serious consequences.

In tropical rain forests and savannahs, fruit-eating bats are the most important seed dispersing animals. In fact, one recent West African study showed bats to be far more effective than birds. Bats also are the primary pollinators of numerous tropical plants. More than 130 genera of trees and shrubs already are known to rely on bats for pollination, and many more such relationships await discovery.

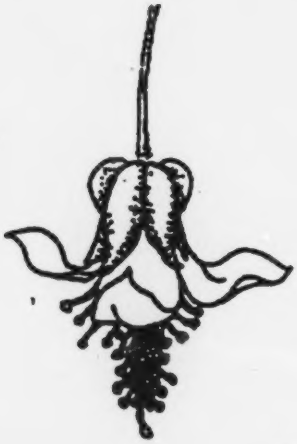
We are only beginning to understand the importance of such bats, but already their ecological and economic impact on rain forests is obvious. Recent studies demonstrate that seed dispersal activities of bats can be critical to reforestation of clear-cut areas, and that many of the tropics' most economically important plants depend on bats for propagation. Over 300 plant species in Southeast Asia, tropical Africa, and the Pacific islands rely on flying foxes (bats of the family *Pteropodidae*) for pollination and seed dispersal, and at least 134 of these species yield products used by humans.

The nearly endless list of valuable products from these plants includes many grocery store fruits such as peaches, bananas, and avocados as well as kapok and hemp fibers for surgical bandages, life preservers, and rope, latex for chewing gum, prized lumber for furniture and crafts, beads for jewelry, and carob for candy.

Many of these products are of considerable economic importance. For example, regional harvests of durian fruit in Southeast Asia and iroko timber in West Africa each amount to annual sales of over $100 million. The former requires bats for pollination and the latter for seed dispersal. Even for plants such as bananas that are now vegetatively produced on plantations, wild banana species provide important genetic reservoirs for development of new, more productive or disease resistant varieties. Humans are far from outgrowing their long dependence on bats.

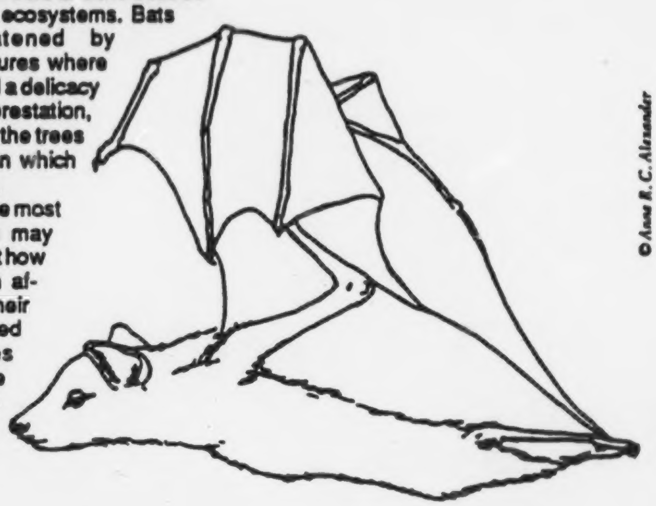
Despite the obvious value of bats, misinformation and misconceptions about bats and their habits have led to the destruction of thousands of bat caves and other roosts, which have been poisoned, blown up, or bulldozed shut. Such uninformed attempts to control bats have led to the killing of millions of beneficial bats and the destruction of entire cave ecosystems. Bats are also threatened by overharvest in cultures where they are considered a delicacy and by tropical deforestation, which is destroying the trees and other plants on which many bats depend.

In many cases the most important question may not be extinction, but how many bats we can afford to lose before their pollination and seed dispersal activities become inadequate to preserve the balance of the rain forest ecosystem. Can rain forests survive without bats? We hope that through prompt action to save large but vulnerable bat populations we will avoid this ultimate and probably disastrous test.



For further information about bats in the world and in your own backyard, contact: Bat Conservation International, P.O. Box 162603, Austin, TX 78716-2603, 512-327-9721. An excellent classroom activity on tropical bats appears in: *Vanishing Forests Teacher's Manual* (see "Curriculum Materials" in Resources section).

—From: *BATS*, 1983, newsletter of Bat Conservation International. Reprinted with permission. See also, "Flying Foxes and Economics," an article documenting how tropical economies depend on bats in *BATS*, Spring 1988, Vol. 6, No. 1.



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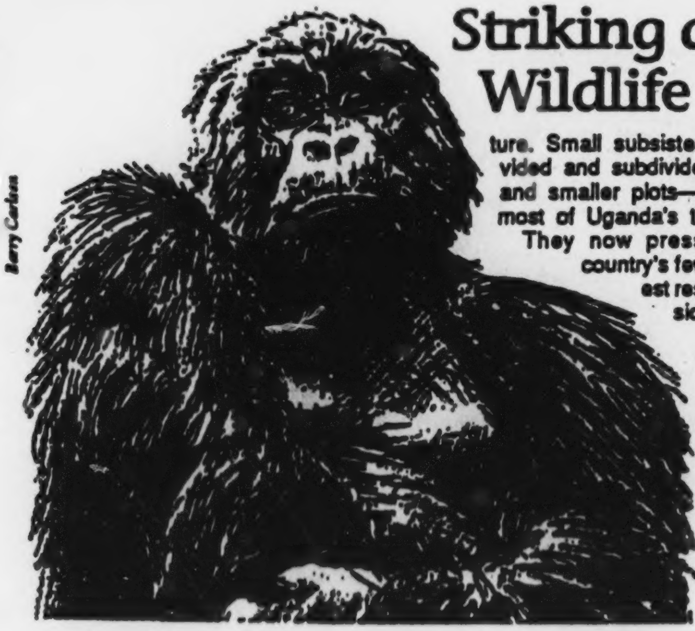
Striking a Balance Between Wildlife and People



At one time, the mountain gorillas of Uganda's Impenetrable Forest lived isolated and undisturbed in their rich and moist tropical forest home. Family groups led by large silverback males peacefully roamed through the forest eating wild celery and other herbs, basking in the noontime sun, and sleeping at night in leafy tree nests.

Downstream of the gorillas' steep forest-covered habitat, people tilled Uganda's rich and fertile farmland fed by clear stream water, which flowed from the forest watershed.

Like so many other African countries, however, the explosion of Uganda's population in recent years has rapidly eroded a delicate balance between people and nature. Small subsistence farms—divided and subdivided into smaller and smaller plots—have replaced most of Uganda's tropical forests. They now press against the country's few mountain forest reserves on every side.

Local people are not able to meet their basic need for food, water, and shelter on these simple farms. They are forced to supplement their meager living with the reserve's wildlife, wood, and other resources. However, the traps they lay to capture small animals often snare the hands and feet of gorillas instead, which can die from the infections that result. Other human activities disturb the gorillas' quiet lives and destroy their habitat. Mountain gorillas are the most endangered of the great apes and one of the most endangered species on Earth. Fewer than 400 individuals remain in the wild.

Until recently, Uganda's gentle gorillas were fast being wiped out. Fortunately, both the region's people and wildlife are today benefiting from a program designed to find ways to meet human needs without destroying natural resources. The innovative Wildlands and Human Needs Program, sponsored by World Wildlife Fund, is working with local people to identify their priority concerns and develop sound solutions to environmental and economic problems. For example, in a cooperative program with CARE, WWF is training Ugandans near the Impenetrable Forest to raise domestic animals as an alternative source of food. Farmers are being encouraged to grow various species of trees in small garden plots instead of logging within the reserve.

The Wildlands and Human Needs Program is addressing the problems of impoverished rural people who ironically often coexist with some of Earth's most biologically rich habitats, especially tropical rain forests. The program, which is now implementing over twenty projects around the world, is premised on the fact that, if rural people are unable to meet their basic needs, they will inevitably expand their activities into wildlife parks and reserves. On the other hand, if ways can be found for wildlands to provide benefits for people without ecosystems being destroyed in the process, then conservation will become an ally rather than an impediment to local development.

World Wildlife Fund believes that conservation that ignores massive human needs will not be able to command the commitment of government leaders and local communities. It's goal is to improve the quality of life of both the people and the wildlife of our Earth. 𝛕

—From: *Focus*, Summer 1989, newsletter of World Wildlife Fund. Reprinted with permission.

Curious about Macaques? In Love with Lemurs?

Discover New Worlds at Wisconsin's Primate Center

"A critical concern among primatologists and others worldwide is the question of endangered and threatened nonhuman primates. Loss of natural habitats, poaching, and unenlightened management of resources have put many nonhuman primates—Africa's mountain gorillas, the orangutans in Asia, and the lemurs of Madagascar—on the verge of extinction," says Larry Jacobsen, director of the Wisconsin Regional Primate Research Center library at UW-Madison.

To assist scientists, students, teachers, and other interested individuals in obtaining information about primate biology, ecology, and conservation, the WRPRC maintains one of the world's best lending libraries. Holdings include a superb collection of audiovisual materials that support research, teaching, and conservation. Slide sets, videotapes, posters, and audiotapes are available for loan. A catalog of WRPRC audiovisual holdings is available from the state Reference and Loan Library through your public library.

For further information, contact: Larry Jacobsen, Library Director, WRPRC, UW-Madison, 1223 Capitol Ct., Madison, WI 53715-1299, 608-263-3512, FAX 608-263-4031. 𝛕

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Asian Farmers: Stewards of Amazonia

It's rather revealing to see a Japanese farm, which might be at best 100 acres in size—that would be a large operation—side-by-side with a 3,000 acre ranch, and the Japanese farmer is employing more workers and making much more money. It just illustrates how intensive farming of the right crop, in this case intensive farming of a high-value crop, can more wisely use land.

—Christopher Uhl

by Christopher Uhl and Scott Subler

We are driving through the morning mist along rut-ridden "highways" 200 miles inland from the mouth of the Amazon River. A monotonous landscape stretches before us: vast expanses of beaten pasture, conquered by weeds and spiny palms and broken occasionally by small plots of tired crops straining, in the exhausted, infertile soil, to provide the subsistence for local Brazilian farmers.

But ahead, in the lifting fog, we behold a different landscape: neat rows of healthy-looking vine and tree crops beyond which spread almost forest-like patches of trees. Rounding the bend, we come to a wood-frame farmhouse surrounded by a well-kept garden. We have arrived at our destination, the municipality of Tomé-Açu, and as we leave the car, are greeted by strains of kabuki music coming from within the house. We cross two small wooden bridges over a tiered fish pond to shake hands with Takeshi Ito, 62, who has owned this farm for the 32 years since having left Japan.

Farmer Ito and hundreds of Japanese colonists like him were to open their homes and farms to us as we traveled the back roads and river systems of the Brazilian Amazon. We were looking for small farming communities of Japanese immigrants. Our goal was to try to understand if, and how, the Japanese are able to practice successful permanent agriculture in a region where past attempts at agriculture had always ended in failure. Their experience might provide some clues to the sustainable use of Amazon forest resources by all Amazonian peoples.

Museu Goeldi, Belém, Pará, Brasil

pineapple
Abacaxi (*Ananas comosus*)

cacao tree: The beans inside the fruit (pod) are used to make chocolate.

Tina Isom

As we visited with the Japanese farmers we were repeatedly struck by the great diversity of their farms. Walking around a single farm we encountered strikingly different planted areas—a variety of crops planted alone and in mixture, and plots in many different stages of development. Instead of the crop rotation familiar in the temperate zone, the Japanese tend to overlap crops, planting some on the same piece of land on which other crops are still developing or bearing fruit.

Although each farmer seemed to have his own idea about the best crop succession, a typical scheme might be as follows: following forest cutting and burning, some combination of short-lived annuals such as tomatoes, peppers, squash, or beans; planted among these, but at a wider spacing, one or more vine species, commonly spice pepper or passion fruit, as well as short-lived tree or bush species such as papaya or guaraná; at some stage, interplanted with the current crops, long-lived tree species like rubber, oil palm, mango, or Brazil nut. As sites develop from the annual stage to the long-lived perennials stage, they become forest-like.

There are many potential advantages to perennial "polyculture," as the farmers pointed out. For example, they believe that mixing plant types having different growth habits and nutrient requirements makes fuller use of the available soil nutrients, thus reducing the need for fertilizers. They also believe that growing crops in combination reduces problems with pests and disease; if outbreaks do occur, the presence of different cultivars lessens the risk of farm failures.

Polycultures also reduce labor. By superimposing two crops on the same plot of land (for example, spice pepper and rubber), only half as much land has to be weeded and fertilized.

With many plots, each with different crop combinations or in different successional stages, day-to-day management is complex, and the farmer has his hands full. Brazilian workers do most of the manual labor, although Japanese family members often pitch in.

Farmers improve the fertility of the inherently infertile soils through large additions of chemical and organic fertilizers, the latter often obtained from farm animals and crop residue. Through years of experimentation, the farmers are learning how to best apply nutrients.

Just as important as fertilization may be the emphasis on high-value, low-volume crops such as black pepper, rubber, cacao, citrus, oil palm, and papaya. With these, the farmers harvest only a small portion of the plant biomass while maintaining a permanent cover for the soil, reducing erosion.

Most farmers we talked with showed great vigilance in defense of their fields. Having learned who their enemies were and how they lived, they attempted to thwart major outbreaks of insect pests or fungus rot. Through time, farmers have discovered many appropriate pest management techniques (e.g., digging trenches during rainy periods to increase drainage and reduce fungal root rot) and government extension officers have adopted their practices as part of official recommendations.

Marketing is of equal importance. Farmers choose their crops carefully to correspond with their distance to market. As well, the important crops are all of high value, a result of their desirability and relative scarcity.

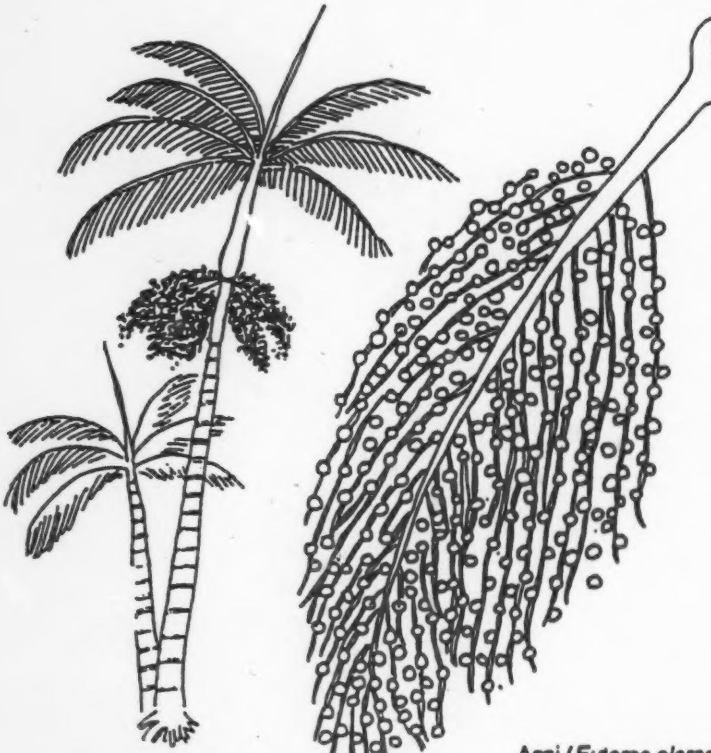
Almost all of the Japanese farm communities we visited had a marketing cooperative. Herein lies another element of their success. We know from the writings of geographers such as Nigel Smith that one reason for the failure of Brazil's much-heralded Trans-Amazon resettlement scheme was lack of credit, supplies, and marketing networks.

The Japanese cooperatives provide inexpensive farm equipment, materials, access to technical advice, and low-interest loans. They market established crops and help develop markets for the new crops farmers are always experimenting with to diversify their operations. Through cooperatives, the Japanese are able to assert marketing power and obtain the security needed in the risky business of agriculture in the Amazon basin.

We learned that cultural traditions, innovative farming techniques, and marketing acumen have enabled these Japanese-Brazilians to achieve a remarkable success story in the development of sustainable agricultural systems in Amazonia.

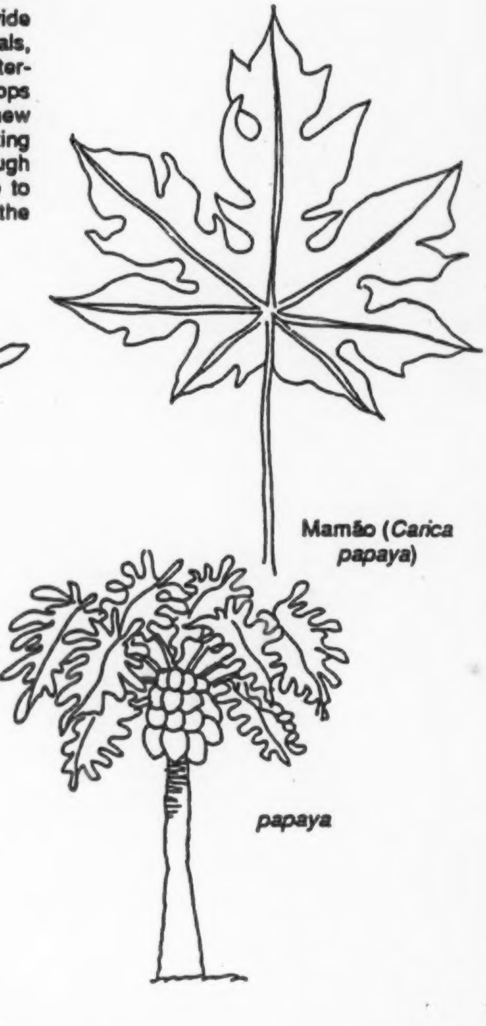
—Condensed from article in: *Garden*, Sept/Oct 1988. Magazine of the New York Botanical Garden, Bronx, NY 10458. Reprinted with permission.

Note: Many articles in the Nov/Dec 1990 issue of *Garden* focus on the tropics. The issue is entitled: "Botany With A Human Face: A Special Issue on the New Ethnobotany."



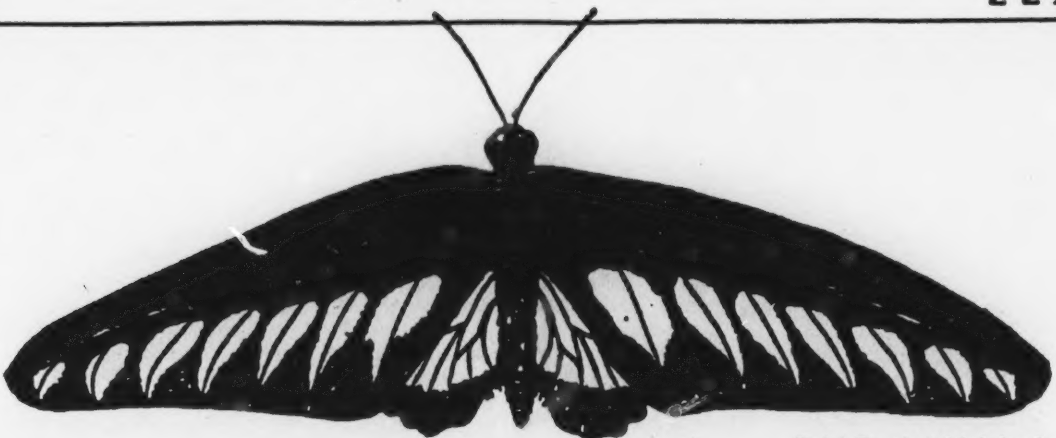
Museu Goeldi, Belém, Pará, Brazil

Açai (*Euterpe oleracea*)



Mamão (*Carica papaya*)

papaya



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Rajah Brooke's birdwing butterfly

Animal Farming Saves Forests

by Noel Vietmeyer

A few miles inland from Popondetta on the north coast of Papua New Guinea is a hand-lettered, misspelled sign that reads "Orari Butterfly Falm." All around, the land is flat and nearly bare. Only months before, it had been jungle containing thousands of species of plants and animals; now it is row upon row of oil-palm seedlings standing in raw red soil.

Down the trail behind the sign, however, towers a solitary clump of almost undisturbed trees—the last remnant of the primeval forest. Hidden in its midst, a small, pleasant house stands on stilts.

Down the steps strolls the home's owner, Roderick Orari, a tall New Guinean with an engaging smile and a confident manner. He stops beside a wire strung between two trees. On it, looking like a miniature washing on a line, hang more than 100 tiny gray lumps, each about the size of a person's thumb. Of these he is extremely proud.

Orari is a rancher whose "livestock" spends part of its life hanging motionless on the line in his yard. It has six legs. But don't be misled: ounce-for-ounce it is probably more valuable than any four-footed livestock anywhere. It is certainly more beautiful. Roderick Orari, you see, is a butterfly farmer. Within a few days, the gray chrysalises hanging on his line will hatch into beautiful birdwing butterflies worth perhaps $100 on international markets.

Throughout the tropics, lush forests are increasingly falling to the ax, the chainsaw, and the bulldozer. That is well known, but solutions to the problem are scarce. That's why Orari is important. He is demonstrating an alternative. In the long run, his approach could save many threatened trees. Whereas cattle ranching creates an incentive for forest destruction, butterfly ranching creates an incentive for forest protection. It makes the standing forest an economic asset: the trees are the source and sustenance of the livestock; as they go, so goes the ranch.

Of course butterfly ranching alone cannot halt the chainsaws, but farming many of the numerous animals that require trees for survival could substantially reduce the devastation. For almost two decades, the government of Papua New Guinea has led the way in testing rain forest organisms as farm animals. It has "ranches" for butterflies, crocodiles, wallabies, deer, and two types of birds: cassowaries and megapodes.

This unusual approach has brought worldwide kudos from conservation groups because it creates economic incentives for preserving habitats and keeping their natural populations healthy and productive.

Prowling his 60-foot-tall "pastures," Roderick Orari is doing more than looking at butterflies—he is earning money without cutting down the rain forest. Although unfamiliar with modern science, he is pioneering a new era in world forestry and agriculture. Others are doing the same thing.

In Panama, a Smithsonian Institution research facility is creating a new profession: iguana farmer. The plan is based on the principle that native species of animals and plants should be considered for domestication and cultivation, as opposed to the use of introduced exotics.

Researchers chose the green iguana. Throughout much of Latin America, this large tree-dwelling, leaf-eating lizard is a popular food. Many people willingly pay more for its meat than for fish, poultry, or beef. To fill the demand, the lizards are hunted by rifle, slingshot, trap, noose, and dog. In some places they come to market by the truckload.

That is, they used to. Because of human appetite for both the animal and its forests, the iguana is now plummeting toward extinction. The Smithsonian researchers, in cooperation with the Panamanian government, are now producing large numbers of green iguanas in a small, tree-covered area.

The project is creating not only a preserve, but also a village resource. Lizard meat tastes somewhat like chicken and the small, leathery eggs are considered special delicacies and are said to cure various ailments.

The key is to get local people to appreciate and care for the resource. Since 1984, the project has been releasing farm-bred hatchlings and yearlings into areas from which wild iguanas long ago disappeared. So far the newcomers have established themselves and are thriving. People in nearby villages are looking after them and are maintaining strips of trees on their land, just for these so called "chickens of the trees."

In the future, iguanas farmed in forests could become an important resource for much of Latin America. This project is yet another potential way to keep tropical trees standing while people still get the food and income they need to survive.

Farming forest species is a whole new approach to animal husbandry—one that neatly blends the interests of livestock producer and forest conservator. The bottom line is to develop it to the point where standing trees are worth far more than felled forest.

It may seem strange to think this way, but all of us interested in trees should work to ensure the success of those who would farm butterflies and iguanas. When they win, many forests will stand tall and safe.

—Condensed from: "Animal Farming Saves Forests," in *American Forests*, Nov/Dec 1988. Reprinted with permission.

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Tropical Forest Products

Many products we use everyday have their origins in tropical rain forests. Some of these include:

Woods: balsa, rosewood, teak, mahogany, sandalwood.

Houseplants: *Anthurium*, *Dieffenbachia*, fiddle-leaf fig, parlor ivy, rubber tree, silver vase bromeliad, Swiss cheese plant, *Croton*, *Dracaena*, *Philodendron*, *Schefflera*, *Spathiphyllum*, zebra plant.

Spices: allspice, cardamom, chili, cloves, mace, paprika, tumeric, black pepper, cayenne, cinnamon, ginger, nutmeg, vanilla.

Fruits: avocado, breadfruit, durian, guava, lemon, mango, orange, passion fruit, plantain, tangerine, banana, coconut, grapefruit, jackfruit, lime, papaya, pineapple.

Vegetables and Other Foods: Brazil nuts, cashew nuts, chocolate, cucumber, macadamia nuts, okra, pepper, tea, cane sugar, chayote, coffee, hearts of palm, manioc/tapioca, peanuts, cola, sesame seeds.

Other products, and their uses, include:

Fibers: bamboo—furniture, baskets; jute/kenaf—rope, burlap; kapok—insulation, life jackets, soundproofing; raffia—rope, cord, baskets; ramie—cotton-ramie fabric, fishing line; rattan—furniture, wickerwork, baskets, chair seats.

Oils: bay oil—perfume; camphor oil—perfume, soap, disinfectant, detergent; cascarilla oil—confections, beverages; coconut oil—suntan lotion, candles; eucalyptus oil—perfume, cough drops; palm oil—shampoo, detergents; rosewood oil—perfume, cosmetics, flavoring.

Gums and Resins: chicle latex—chewing gum; copaiba—perfume, fuel; copal—paints, varnishes; gutta percha—golf ball covers; rubber latex—rubber products; tung oil—wood finishing.

Pharmaceuticals: annatto—red dye; curare—muscle relaxant for surgery; diosgenin—birth control pills, steroids, asthma and arthritis treatment; quassia—insecticide; quinine—anti-malarial and pneumonia treatment; reserpine—sedative, tranquilizer; strophanthus—heart medication; strychnine—emetic, stimulant; tuba root—rotenone, flea dip. T

—From: *Tropical Forests and the Indiana Connection.* (See "Curriculum Materials" in Resources section.) Reprinted with permission.

Chico Mendes: His Spirit Lives On in Amazonia

On the evening of December 22, 1988, in the river town of Xapuri in Brazil's remote western state of Acre, Francisco "Chico" Mendes Filho, 44, was gunned down as he went to bathe in his backyard outhouse.

Mendes, president of the 70,000 member National Rubber Tappers Union, had become famous for his militant defense of the Amazon rain forest and its traditional inhabitants. In the violent backdrop of the Amazon frontier Mendes' work had earned him the United Nation's "Global 500" environmental award in 1987. It also made him a marked man.

Mendes' primary concern was less the "greenhouse effect" than the "human effect"—the impact of deforestation on his fellow *seringueiros*, or rubber tappers.

At the age of seven, Mendes learned to tap the wild trees for rubber latex and to hunt for food. The forest provided Mendes' only education until he met a dissident army officer who had fled to the jungle following the 1964 military coup. The officer, who began tapping rubber near Mendes, took a liking to the youth and taught him reading and, according to Mendes, "the principles behind trade unionism."

In the '70s, Mendes, a modest man, began to challenge the exploitation of the *seringueiros* by rubber merchants, land speculators, and cattle barons. The Brazilian government had begun cutting a road into Acre, and cattle ranchers and land speculators from southern Brazil moved in, slashing and burning vast sections of the forest. Often the rubber tappers would return home at the end of the day only to find a pile of ashes. On what was once lush jungle, the ranchers then grazed a few cattle on land that rapidly lost its capacity to grow even grass.

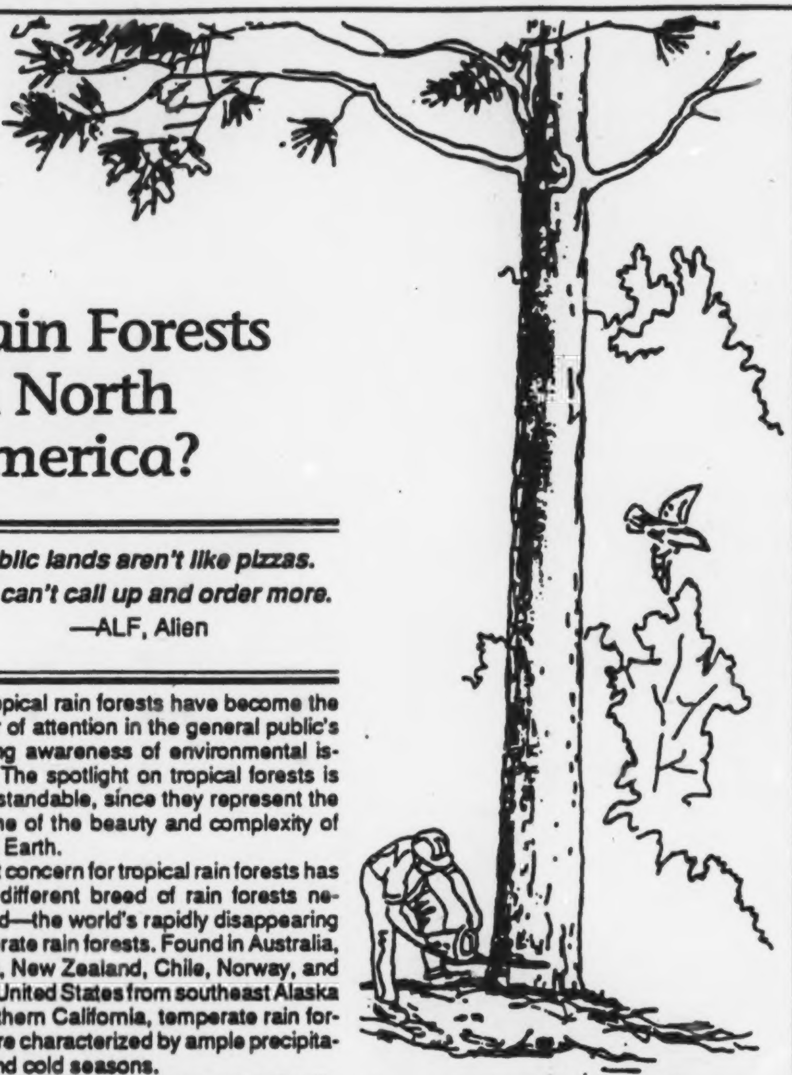
During the past 10 years, Mendes and the rubber tappers have tried to protect their rain forest through nonviolent actions called *empates* (standoffs). During these acts of civil disobedience the rubber tappers would come with their entire family to confront the chainsaw crews that cleared the forest for ranchers.

In April 1988 workers cutting the forest for two ranchers, Darli and Alvarino Alves, fired on a group of rubber tappers staging an *empate*. Two people were wounded. To head off further violence, Acre's governor declared the area the first "extractive reserve." Mendes had pioneered this promising idea for conservation and future development of the Amazon. Tappers, by allowing wild rubber trees to recuperate after extracting the latex, make their income from the forest in a way that is sustainable.

The Alves brothers, who claim to own the same land occupied by the extractive reserve, are widely believed to have ordered the killing of Mendes.

Mendes is survived by his wife, Ilzamar, and two children. Despite his tragic death, Mendes' spirit will undoubtedly live on in a battle destined to repeat itself well into the future. In his life, Chico Mendes taught us an important lesson: that the global ecological crisis requires environmentally sound solutions that are also socially just. In his death, he leaves us a challenge: to see, in some measure, that he did not die in vain. T

—Compiled from articles in: *In These Times*, Jan. 11-17, 1989; *The Leader*, Feb 1989, National Wildlife Federation; and *EDF Letter*, Feb 1989, Environmental Defense Fund.



Rain Forests In North America?

Public lands aren't like pizzas. You can't call up and order more.
—ALF, Alien

Tropical rain forests have become the center of attention in the general public's growing awareness of environmental issues. The spotlight on tropical forests is understandable, since they represent the epitome of the beauty and complexity of life on Earth.

But concern for tropical rain forests has left a different breed of rain forests neglected—the world's rapidly disappearing temperate rain forests. Found in Australia, Japan, New Zealand, Chile, Norway, and in the United States from southeast Alaska to northern California, temperate rain forests are characterized by ample precipitation and cold seasons.

The rain forests of our country's Pacific Northwest are seriously threatened. Deforestation of ancient growth and temperate rain forests in Oregon, Washington, and Alaska is as high as 2% annually, exceeding the rates of deforestation in countries like Brazil, which is losing its forests at an annual rate of 0.4%. Alaska's Tongass National Forest is the last largely intact rain forest in North America. The U.S. Forest Service plans to harvest an estimated 20,000 acres annually, and corporations owned by Alaskan natives will probably match that figure. In the Pacific Northwest, the Forest Service clearcuts approximately 60,000 acres per year.

If harvest continues at this rate, in just 20 years the last stands of centuries-old trees will be gone—resulting in untold damage to the environment as well as lost jobs and income for loggers. The economies of many communities, especially in Oregon, are dependent on Federal timber sales and thousands of jobs are at stake. A current major challenge is finding ways to diversify local economies and assist communities in transition.

While forest management plans include replanting trees, ecologists argue that the complex ancient forest ecosystem that has evolved through thousands of years supports a diversity of life not found in secondary growth forests or silviculture plantations. The issue is not tree growing, concerned citizens argue, but saving whole communities of plants, fish, and wildlife.

"At a time when plant and animal species are disappearing at an alarming rate, and the United States is urging developing nations to mend their rapacious ways, many scientists argue we can ill afford to lose another big chunk of nature's legacy," writes Elliot Diringer of the *San Francisco Chronicle* about the Pacific Northwest's ancient forests.

The fate of "our" rain forests has spurred considerable and complex political debate. Bills calling for forest policy and timber harvest reform are currently on Capitol Hill (e.g., the Tongass Timber Reform Act, and the Ancient Forest Protection Act [HR4492]). For information, contact: U.S. Forest Service, Pacific Northwest Regional Office, Public Affairs, 319 SW Pine St., Portland, OR 97208; Ancient Forest Alliance, National Audubon Society, P.O. Box 462, Olympia, WA 98507; The Wilderness Society, 610 SW Alder St., Suite 915, Portland, OR 97205; American Forest Council, 1515 SW 5th Ave., Suite 518, Portland, OR 97205; American Forestry Association, 1516 P St., NW, Washington, DC 20005. Also, see article: "Will We Save Our Endangered Forests?," *National Geographic* magazine, September 1990.

—Based on information from: National Audubon Society.

Ancient Forest Facts

- Nearly 400 years ago, around the time when the Pilgrims arrived, North America was covered with approximately 850 million acres of virgin forest. Today just a few million scattered acres remain.
- Every day, 170 acres of ancient forest are logged, amounting to nearly 100 square miles a year.
- Only 5%-7% of our Northwest ancient forests still exist (or to put it another way, over 90% of them are gone), and much of what is left is in fragmented, isolated patches.
- For every mile of road built in unfragmented old growth, approximately 97 acres of old growth forest are altered by the effects of the construction.
- In the last fifty years, the U.S. Forest Service has cut 360,000 miles of roads in our National Forests.
- If logging continues at current rates, all remnants of ancient forests will be gone in 20 years (by the year 2010).
- America's ancient forests are among the most complex ecosystems on earth, providing habitat for dozens of species of animals that may not be able to survive in a second growth forest. Forests in the Pacific Northwest contain twice as much organic material per acre as a tropical rain forest.

What Good Is A Prairie?

by Tom Huggler

In North America, the tallgrass prairie, containing more than 300 species of flowers and grasses—including some that grew to a height of nine feet—was unlike anything the settlers had ever seen. European immigrants, lumbering across the midcontinent in their prairie schooners, often referred to the trackless expanse as a "sea of grass." And why not? It was 600 miles wide at its widest point.

Today the tallgrass prairie is gone, except for snippets here and there along railroad rights-of-way, unmown pioneer cemeteries, and small plots managed as preserves. The largest remaining stand, the Konza Prairie in Kansas' Flint Hills, covers only about 13 square miles.

"What good is a prairie?" a friend asked me recently. It was an honest question, and I found myself giving the expected answers: There isn't much prairie left; they were formed over millennia by an exacting brew of climate, glaciation, organic decay, and other factors; they provide an ecological niche for a great number of plants, birds, and mammals. Then I said, "To really appreciate prairie, though, you have to walk in one."

As one observer wrote in 1855 about a prairie near present-day Kalamazoo, Michigan: "Beneath, about, and beyond me, as far as the eye could reach, was spread out, in undulating elegance, an emerald carpet of nature's choicest fabric, inlaid profusely with flowers of every imaginable variety of name and tint—gorgeous and fascinating as the most brilliant hues of the rainbow."

Interest in prairie is growing rapidly. "Prairie has become a cult, especially with young people," said Bertha Daubendiek of the Michigan Nature Association. The reasons lie with a growing public awareness that prairie is special and that it is nearly all gone. John Madson's eloquent book, *Where The Sky Begins* (Sierra Club, 1982), has helped to awaken a whole generation of readers to prairie's value. Restoration projects are another way to influence people to be curious and to care.

A "prairie consciousness" is stirring among the private sector, too. The Steelcase Company in Grand Rapids, for example, recently reconstructed a shortgrass prairie as part of its landscape. More and more landscaping companies specialize in natural landscape architecture, including prairies.

With increased understanding and appreciation, momentum is building to preserve and restore natural habitats. As Aldo Leopold once said, "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man."

—Condensed from article in *Michigan Natural Resources* magazine, March/April 1988. Magazine of Michigan Department of Natural Resources. Reprinted with permission.

Wisconsin: Then and Now

Consider this dramatic picture:

- The prairies that once covered over 2 million acres of Wisconsin are now 99.9% gone.
- Oak savannas, grasslands with scattered big trees, once covered 15% of the state and have nearly disappeared. Less than .02% of the original 7,300,000 acres is known to remain in scattered sites.
- Seventeen species of animals—four birds, six mammals, and seven fish—have become extinct in Wisconsin.
- Eleven bird species are endangered in Wisconsin; so are: 23 species of invertebrates, nine fish, one amphibian, six reptiles, and three mammals.
- One hundred eighteen of Wisconsin's plant species are endangered or threatened.
- One quarter of Wisconsin—almost 10 million acres—was wetland in the early 1800s, prior to the arrival of European settlers. Now only half of these original wetlands remain.

—From: *The Nature Conservancy*, Fall 1988. Newsletter of the Wisconsin Chapter of The Nature Conservancy. Facts updated 1990.

What's Happening in the Schools

Students and Teachers Unite to Save Tropical Rain Forests

by Bruce Calhoun, Teacher, Dodgeville High School, Dodgeville

A unified effort among teachers and students to help stop environmental destruction is being led by an organization born at Dodgeville High School. "Save The Rainforest" began in 1988 when my 10th-grade biology students had just finished a unit on rain forest ecology and decided they wanted to do something about worldwide deforestation. We began writing letters, inviting other schools to join "Save The Rainforest" (STR) and create a network of schools dedicated to saving tropical rain forests.

By the end of 1989, we had written to 32,000 teachers; more than 7,000 teachers, elementary through high school, joined. We actively campaign to save rain forests and other habitats by circulating petitions, educating the public, and raising money for conservation projects. STR is cooperating with similar student groups around the world.

STR groups have been learning about rain forest destruction and how they can prevent it. Their action so far has been to circulate a petition asking the International Monetary Fund (IMF) to reform its policies. IMF restructures the foreign debt of Third World countries, a process that often determines how a country uses its natural resources. To date, IMF has mandated repayment of debts, and Third World countries have often been forced to rapidly exploit their forest and mineral resources to repay the debts. Such exploitation is destroying fragile forest ecosystems and doing little to improve the quality of life for local people.

The petitions seem to be having an effect. IMF's U.S. executive director told Washington environmental groups that he wants to create an environmental department in IMF that will study the impact of IMF policies. This move would be a giant step forward and could ease the tremendous pressure on developing nations to repay their debts.

U.S. students also have been writing letters to their elected representatives in Washington asking them to forgive a portion of the debt owed by developing countries. The letters helped pressure Congress to pass the Global Environmental Protection Assistance Act of 1989. This act allows the U.S. to purchase the commercial debt of Third World countries at rates as low as $1 for each $10 owed. Purchasing commercial debt is better known as debt-for-nature swaps. The debtor country keeps the money it owed and uses it for conservation projects instead.

SAVE THE
RAINFOREST

Participating students worldwide have been involved in education outreach and fundraising. Some schools have constructed model rain forests, complete with vines hanging from the ceiling and taped rain forest sounds (see article, page 23). Other schools have handed out rain forest fact sheets to the community and set up information booths in shopping centers. Clean-a-thons and recycling projects have been popular fundraisers. A high school in Newnan, Georgia, designed a beautiful Save The Rainforest t-shirt and ended up selling bulk orders to schools around the country. The best fundraisers of all, however, have been children in Sweden. Since 1987, they have raised more than $500,000.

Schools use the money they raise to support one of five STR conservation projects: debt-for-nature swaps, land purchase, support of indigenous people, support of overseas environmental organizations, or creating a national park and buffer zone. Every penny that schools raise goes directly to these projects because STR is operated completely by volunteer students and teachers, and overhead costs have been paid through corporate and foundation donations.

Each project is in a different part of the world and uses a different conservation strategy, so the decision-making process becomes both a geography and a civics lesson. Many schools decide to buy rain forest acreage in Costa Rica. This project is especially popular with younger children, who can easily grasp the concept of buying and protecting an acre of land. Other projects range from building up the infrastructure of a newly established park in Central Africa to assisting indigenous people in their struggle against logging companies in Sarawak, Malaysia.

This past summer, 60 teachers and high school students from the U.S., Sweden, and Great Britain traveled to the Monteverde Forest Preserve in Costa Rica for a two-week Rain Forest Ecology Course designed by STR and the Monteverde Institute.

Teachers and students can get involved with many other related activities through STR. For example, STR worked with the United Nations Environment Programme and The Children's Alliance to Protect the Environment to promote International Beach Appreciation Day in September. On this day, children from around the world cleaned river, lake, and ocean shorelines. They conducted water quality studies and research projects pertaining to local water pollution.

If you want to join STR, send a postcard with your name and school address to: Save The Rainforest, Dodgeville High School, 912 West Chapel, Dodgeville, WI 53533. You'll receive rain forest campaign materials; a fall 1990 resource list; an application form for the 1991 Rainforest Ecology Course; and *STR Reports* every January, May, and September.

—From: *NSTA Reports!*, Sept 1990. Reprinted with permission.

Tropical Forest "Grows" in Wisconsin School

ELM Creative Arts School

by Darrel Jacobs, Principal, ELM Creative Arts School, Milwaukee

Imagine stepping quietly through the rain forest like the Yagua Indian hunter, carrying your blowgun, looking for an evening meal. All around you are the sounds of monkeys, parrots, and hummingbirds.

But not far away are the sounds of school bells and the clatter of children as they laugh and learn. Where are you?

At the ELM Creative Arts School in Milwaukee. In the fall of 1989, teachers and students transformed a gallery room into a multi-sensory rain forest experience. UW-Milwaukee art majors from Dr. David Baker's art theory class helped our school create the forest by researching background information, writing a teacher's guide, and constructing the large rain forest props. Vicki Samolyk, Art Specialist at ELM, carried on the project with the help and enthusiasm of 385 students in grades K-5.

The gallery became a rain forest, complete with large three-dimensional trees with airplant orchids and climbing vines clinging to their branches and trunks. Looking up, you saw the upper canopy of the forest, with hundreds of green leaves shielding your view of the sky and letting in little light. Large, brightly colored butterflies and painted papier mache parrots and macaws "flew" through the forest. Dozens of student-made clay masks—expressions of human emotion in natural materials—peeked out at you from behind the bushes. Rain forest animals—an orangutan, a two-toed sloth, an ocelot, a boa constrictor, and an anteater—lived in the forest (a composite of forests from different regions of the world).

Humans lived in our forest, too. A native dwelling was made of tree branches, bark, and straw. Inside were activities for children: making bead necklaces from different seeds, sketching with markers and chalk, listening to the sounds of the rain forest.

On the wall a large world map showed where rain forests occur in the world, and how many are being destroyed. These rain forests in danger include the temperate forests of our own Pacific Northwest. Inspired by what they learned about rain forests, students wrote letters to their national legislators about their concerns for the future of these invaluable ecosystems.

Near the map hung Henry Rousseau's painting, "Exotic Landscape," which depicts monkeys playing in their natural forest habitat. We hope rain forests continue to exist throughout the world, to inspire the arts and to enrich life in many other ways. ₸

For information about the ELM Creative Arts School Rain Forest, contact: Darrel Jacobs, Principal, ELM Creative Arts School, 2616 W. Garfield, Milwaukee, WI 53205, 414-933-0305.

Get into Project WILD Wisconsin

Project WILD/ Learning Tree Update

Project WILD/Learning Tree
P.O. Box 7921
Madison, WI 53707
608-266-0870/267-2463

PROJECT LEARNING TREE

Let's Hear From You!

We'd like to hear from you about your classroom WILD/PLT activities and action projects. Any news and project items you send will be incorporated into what we hope will be regular feature in the WILD/PLT section of *EE News*. This will provide us with needed feedback from you as well as provide free publicity for your school or group and an opportunity for you to inspire and challenge others in the WILD/PLT educator network. Call or write us at the Project WILD/PLT Office today!

WILD and Learning Tree Workshops

WILD and Learning Tree workshops are listed in the Calendar section of *EE News*. New workshops are always being scheduled and sometimes miss being announced in *EE News*. Contact the Project WILD/Learning Tree Office for an update of those being offered in your area.

WILD Ideas for Teaching About Rain Forests

by Susan Gilchrist, Project WILD Research Coordinator, DNR

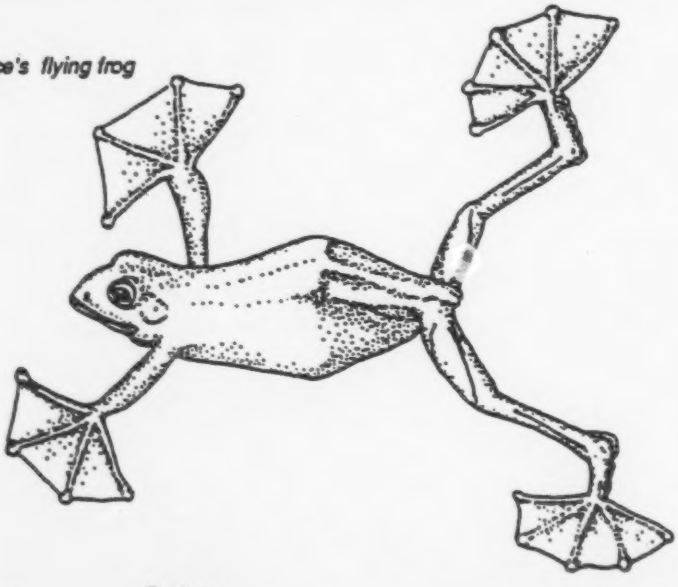
While visiting classrooms during the past year to conduct research on the effects of Project WILD, I observed many dynamic, creative activities. Many focused on rain forests—complex, intriguing, and vital ecosystems. I've combined some of the activity ideas from Project WILD Research with the rain forest theme. Feel free to adapt these activity ideas to your specific class or lesson. If you've developed rain forest units or activities you'd like to share with others, please send them to *EE News* for possible publication.

The *Project WILD Guide* contains several activities to teach about the concept of habitat. Rain forests are home to over half of the known plant and animal species on Earth. Investigate some of the intriguing interrelationships among rain forest plants, animals, and their environment, then do "Habitat Lap Sit." Each student is identified as a part of the habitat (food, water, shelter, space), then students form a close circle and sit down simultaneously on each other's laps. The key is to form a tight circle, with no space between people. Then remove one element of the habitat (e.g., by cutting a tree, one removes shelter or a food source). What happens to the circle? Crash! The concept of interdependence becomes clear while everyone has fun.

Rain forests may seem a long way from Wisconsin, but tropical deforestation affects our wildlife (see article on page 11). Half of Wisconsin's 300 bird species migrate and overwinter in Central and South America and the Caribbean. Nearly half of the world's rain forests have been destroyed in the past 40 years and it's estimated the remainder may be destroyed within the next 25 years. An area the size of New York state is lost every year.

Adapt the Aquatic WILD activity "Migration Headaches" by focusing on warblers, tanagers, orioles, or thrushes in-

Wallace's flying frog



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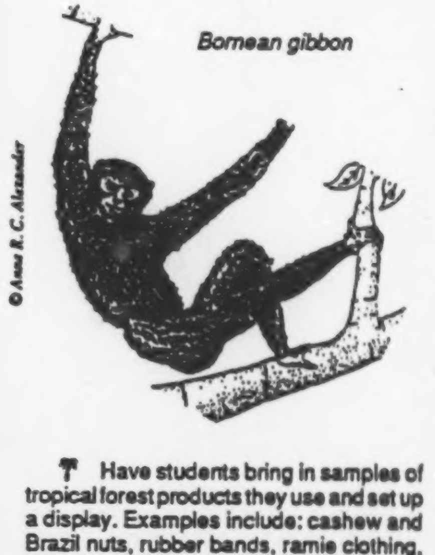
stead of ducks. Instead of wetlands, let the habitat zones represent acres or hectares of forest. Remove the winter habitat (rain forest) at a faster rate than the summer habitat (North American forest), but reduce both. (Remember that during migration many birds need to stop en route to rest and feed.) What happens to the student "birds" each time they migrate and find less habitat? What actions can real students take to address the problem of habitat destruction in both Wisconsin and the tropical regions where "our" birds over-winter?

agouti
Jack Shepherd

T One out of every four prescription drugs is from tropical plants (see list, page 19). For example, alkaloids from the rosy periwinkle of Madagascar have arrested childhood leukemia and Hodgkin's disease. Half a million plants still await analysis, and could supply the wonder drugs of tomorrow. Investigate and discuss possible health implications of tropical deforestation.

What medicinal uses of rain forest plants have indigenous people developed? Investigate the "ethnobotany" of native people, both in the tropics and in Wisconsin. What can we learn from the cultures and traditions of these people? What impacts do economic development and deforestation have on native peoples?


Bornean gibbon

T Have students bring in samples of tropical forest products they use and set up a display. Examples include: cashew and Brazil nuts, rubber bands, ramie clothing, cocoa and chocolate, vanilla, coffee, teak, mahogany, coconut, cinnamon, bananas, guavas, mangoes, coca-cola, medicines, paper (imported eucalyptus pulp is used in Wisconsin to make paper products), etc. (See list, page 19). One class prepared these samples for display at the school open house to educate visiting parents.

Investigate the economic, social, political, and environmental impacts of growing, harvesting, and exporting these products. Are these practices sustainable (is the resource being managed in a renewable way)?

T Read and discuss *The Lorax*, by Dr. Suess, or *The Giving Tree*, by Shel Silverstein.

T Use the Project WILD activity "Adaptation Artistry" to focus on wildlife adaptations for survival in a rain forest. Using a broad array of art materials, students can invent a rain forest creature and explain its adaptations to the whole class.

T Adapt the activity "Meet a Panda" from *NatureScope: Endangered Species*, into "Interview a Jaguar." Make a paper plate into a simple jaguar mask and let the students interview you in that endangered animal role. Stress habitat destruction and unregulated hunting as threats to the jaguar's survival.

capybara

T What happens when the rain forest is chopped down? A number of activities portray the effect of diminishing habitat on wildlife. In Project WILD's "Shrinking Habitat," students in the roles of plants, herbivores, and carnivores are removed from their habitat by developers. The remaining wildlife cannot survive if one of the necessary components of habitat is gone.

Simulate a shrinking habitat by having a student hold one end of a rope while you hold the other across the classroom. Walk towards one wall, sweeping all the students before the rope until they are crowded in a fraction of the classroom. How do they feel? Approach one student, closer and closer, asking the student to tell you when your closeness makes him/her uncomfortable. Discuss feelings towards strangers, especially when crowded in a bus or elevator. Talk about why animals might be uncomfortable when approached by humans or when they are crowded together without enough space. Discuss the effects of airplanes, chain saws, vehicles, construction, and other forms of human intrusion on wildlife in this adaptation of WILD's "Too Close for Comfort." Discuss the concept of carrying capacity.

Asian tapir
Jack Shepherd

T Create a rain forest habitat in the minds of students by using guided imagery. Adapt the Aquatic WILD activity "Riparian Retreat" to the rain forest. Play a tape recording of rain forest sounds (see "Audiovisuals" section of Resources) to assist students with their imagery. Have students describe images they "saw" with their eyes closed, and discuss the diversity of life in the rain forest. Students can draw their favorite rain forest image. Ask students to describe how they'd feel if their forest was cut down.

T Take a field trip to the Milwaukee Public Museum exhibit, "Rain Forest: Exploring Life on Earth" (call 414-278-2702 for information), the Tropical Dome, Mitchell Park Conservatory (call 414-649-9830 for information), or other botanical gardens with tropical exhibits. Give the students a short list of items to find or things to do on the field trip to help focus their interest. Conduct field trip follow-up activities to help clarify and solidify the experience. For example, ask students to write responses to the following: "I did...," "I saw...," "I felt...," "I thought..."

T Consider building a rain forest in your classroom or school activity room (see article, page 23). Each class can add to it over the years. Make "trees" of the cardboard center tube from carpet rolls, covered with crepe paper or construction paper bark and green paper leaves; vines from bits of rope; and flowers of colored tissue paper. Animals can be made of papier mache and other materials.

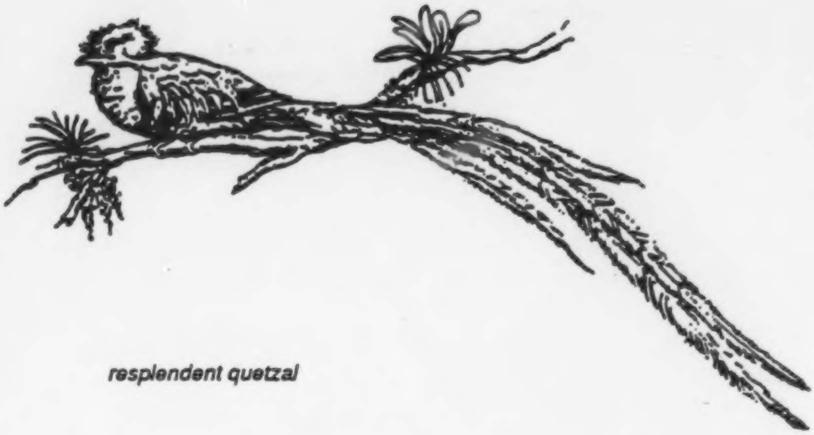
Concepts of rain forest diversity and value, problems of threats to the rain forest, and possible solutions to these threats become apparent as students research the subject for their classroom forest.

giant armadillo

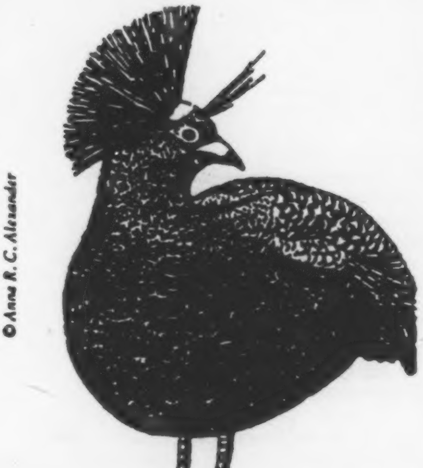
Jack Shepherd

The activity, "Chopping Down the Forest," from the *NatureScope: Endangered Species* (see "Curriculum Materials" section in Resources) demonstrates changes that affect the rain forest environment. Have students stand together in a big group, representing trees in a forest. Place a small electric fan on a desk and turn it on low. Ask a student near the center to report on visibility beyond the "edge of the forest," the light that reaches the "forest floor," and whether he or she can feel the breeze. "Chop down" some of the forest by removing students from the edge until the student in the center reports a change in visibility, light, and breeze. How might changes in these physical factors (temperature, moisture, light availability, air circulation) affect the plants and animals adapted for living in the middle of the forest?

A study reported in *The New York Times*, Nov. 14, 1989, may provide some insights: "...Scientists started studying what happens when expanding cattle ranches create islands of rain forest. 'The hot winds off the pastures dry out the forest edges, and the trees blow over like matchsticks,' said Roger Hutchings, a Colombian scientist. ...Scientists have measured changes in temperatures and humidity as far as 100 yards from the edge of a forest that borders on pasture. In this hotter, drier area other species of trees and bushes invade, often taking advantage of clearings formed by trees knocked over by the wind."


resplendent quetzal

Tina Isom


crested wood partridge

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Investigate the concept of "island biogeography." As human population grows and habitat destruction increases, remaining undisturbed habitats become smaller and more fragmented or unconnected. Biologists know that species on an island-like patch are more vulnerable to catastrophe, inbreeding or lack of reproduction, predation, and other problems that lead toward extinction. What is the minimum size area of rain forest, for example, needed to preserve most species of plants and animals?

A long-term research project (Minimum Critical Size of Ecosystems project) is studying this question in Brazil's Amazon Basin. Researchers are finding that fragmentation creates large areas of "edge" habitat, where shifts in temperature and wind patterns displace deep forest species that can't tolerate hot, dry conditions. Even though a forest may seem intact, some trees can't reproduce because conditions have changed and their pollinators are no longer there. Researchers also are discovering the importance of leaving forest corridors connecting fragments to allow species to move back and forth (see two articles in "Articles" section of Resources).

Investigate examples and impacts of habitat fragmentation in Wisconsin (e.g., impacts of road building on timber wolf populations in northern Wisconsin).

Rain forest destruction not only destroys unknown numbers and varieties of plants and animals, but creates conditions for fire, an unlikely phenomenon in an intact rain forest (see article, pages 12-13). Ask students to consider the impacts of these fires on global climate.

Halting loss of rain forests can help slow global warming. So will planting trees anywhere on Earth. We should note, however, that developed countries burn, per capita, more than 90% of the fossil fuels. Automobiles and light trucks account for 20% for all U.S. CO_2 emissions. What can we do here at home to slow global warming?

Tropical forests play an important role in the hydrologic cycle. Intact forests recycle tremendous quantities of water back into the atmosphere through transpiration, a process that also consumes large amounts of heat. Teach the magic of transpiration by closing a plastic bag around a living tree branch outdoors. Observe the moisture in the bag several hours later and discuss the physiological process of plant transpiration. What impacts might widescale deforestation have on the water cycle?

Students *can act* to help slow the pace of rain forest destruction. See article on page 8 for ideas about what you can do.

I'd like to thank Kevin Ryan, Geri Langman, Susan Scaffidi, Joan Moeschberger, Jeff Barthen, Darlene Freiberg, Coletta Ryan, Lisa Hefty, James Korb, Anne Hallowell, and the staff at Mosquito Hill Nature Center for these ideas.

Note: The teacher's guide, *Tropical Forests and The Indiana Connection*, contains a section of "Tropical Take-Offs" ideas for Project Learning Tree. See "Curriculum Materials" section of Resources.

Milwaukee Public Museum

Rain Forest Resources

The following resources provide information and insights on tropical forests. This list is by no means complete. If you know of other resources particularly helpful to you in your teaching, please let me know so I can share them with others. Send the information to: Anne Hallowell, Editor, *EE News*, DNR Education Programs, P.O. Box 7921, Madison, WI 53707.

Books

The Burning Season. Andrew Revkin. An area of Brazilian rain forest twice the size of California has already been burned to the ground for short-term gain. This book chronicles the life and death of Chico Mendes, the rubber tapper who was brutally assassinated for opposing this destruction. For information, contact: Environmental Defense Fund, 1616 P St. NW, Washington, DC 20077-6048.

Decade of Destruction: The Crusade to Save the Amazon Rain Forest. A companion book for the five-part WGBH Boston TV series about the Amazon (see "Audiovisuals" section below). Cost: $19.95. To order, call: 1-800-247-3912.

People of the Tropical Rain Forest. Julie Sloan Denslow, Christine Padoch, eds. 1988. Central to the tropical forest issue are people—those who have lived there traditionally, those who see the uninhabited territory as the sole hope of land ownership they have never experienced, and those in cities who make the decisions regarding its resources. This fascinating and beautiful book looks at all the people who are involved. Publisher: University of California Press, Berkeley.

Whose Trees? John Bruce (UW-Madison), Louise Fortmann, eds. A look at the complexities of Third World forest issues, focusing on the differing cultural concepts of land and tree ownership and how these affect efforts to promote productive and sustainable forestry practices. Publisher: University of California-Berkeley.

Promoting Environmentally Sound Economic Progress: What the North Can Do. Robert Repetto. This World Resources Institute Report presents the case that solutions to major environmental problems lie in broad-based economic reforms. It explores the relationship between economic production, technology, and environmental deterioration and concludes that any effective action plan to preserve the environment must be viewed through an economic prism. Cost: $7.50, plus $3.00 postage. Order from: World Resources Institute Publications, P.O. Box 4852, Hampden Sta., Baltimore, MD 21211, 301-338-6963.

The Forest for the Trees: Government Policies and the Misuse of Forest Resources. Robert Repetto. 1988. Order from: World Resources Institute Publications, P.O. Box 4852, Hampden Sta., Baltimore, MD 21211, 301-338-6963.

Biodiversity. E.O. Wilson, ed. 1988. The proceedings of a meeting sponsored by the Smithsonian Institution and the National Academy of Sciences in which leading scientists talked about their specialties, including ethics, conservation, extinction, and other topics. Cost: $19.95. Publisher: National Academy Press, Washington, DC.

Saving the Tropical Forests. Judith Gradwohl, Russell Greenberg. 1988. A useful source book for thinking about the causes and effects of tropical deforestation, with many splendidly developed case studies, a number of examples of sustainable agriculture and forestry, and a fascinating section on the restoration of tropical rain forests. Cost: $24.95. Publisher: Island Press.

Amazon. Brian Kelly. 1983. An unforgettable account of an extraordinary adventure through the last great wilderness on Earth. Publisher: Holt, Rinehart, & Winston, New York.

The Primary Source. Norman Myers, 1985. A well-written analysis by one of Britain's leading conservationists of what's going on in the tropical forests—an eloquent presentation of the basic facts and their implications. Cost: $9.70. Publisher: W.W. Norton & Co., New York.

In The Rain Forest. Catherine Caufield. 1986. A beautifully written personal account of the way rain forests really are, using well chosen examples to explore the meaning of those forests to people who live in them and to the rest of us. Cost: $11.95. Publisher: University of Chicago Press, Chicago.

The Enchanted Canopy. Andrew W. Mitchell. A fascinating book filled with information about tropical rain forest canopies around the world. Cost: $29.75. Publisher: Macmillan.

Life Above the Jungle Floor. Donald Perry. A narrative about the author's experiences studying the forest crown and his efforts to learn more about the ecosystem. Gives a feeling for the immensity, complexity, and wonder of rain forest life. Cost: $16.95. Publisher: Simon and Schuster.

Natives of Sarawak: Survival in Borneo's Vanishing Forests. Evelyne Hong. Cost: $10.00. Order from: The Rain Forest Alliance, 295 Madison Ave., Suite 1804, New York, NY 10017.

Tropical Rain Forest in Southeast Asia: A Pictorial Journey. Ken Rubeli. A book of mostly photographs that gives a lavish view of the plants, animals, and indigenous people in the rain forests of Malaysia, southern Thailand, and Indonesia. Cost: $10.00. Publisher: Malayan Nature Society, Kuala Lumpur.

Lessons of the Rain Forest. Suzanne Head, Robert Heinzman, eds. Anthology of essays by leading authorities fully examining the issues surrounding tropical deforestation. Cost: $14.95. Order from: Sierra Club, Dept. SA, P.O. Box 7959, San Francisco, CA 94120.

Emerald Realm: Earth's Precious Rain Forests. Donald J. Crump, ed. 1990. Cost: $9.50. Publisher: National Geographic Society, Washington, DC.

Children's Books

The Kapok Tree. Lynne Cherry. 1990. A magical and beautifully illustrated tale about the wonders of the Amazon rain forest and the marvelous creatures that inhabit it, with a conservation message that speaks to both children and adults. Cost: $14.95. Publisher: Harcourt Brace Jovanovich, NY.

Journey Through a Tropical Jungle. Adrian Forsyth. 1988. Excellent photos of Monteverde Forest Reserve, Costa Rica. Publisher: Simon and Schuster.

My Life With The Chimpanzees. Jane Goodall. This autobiography written for young adults (ages 8-12) is at once a revealing self-scrutiny and an engrossing tale of adventure and commitment that will inspire budding naturalists. Cost: $2.75. Publisher: Pocket Books.

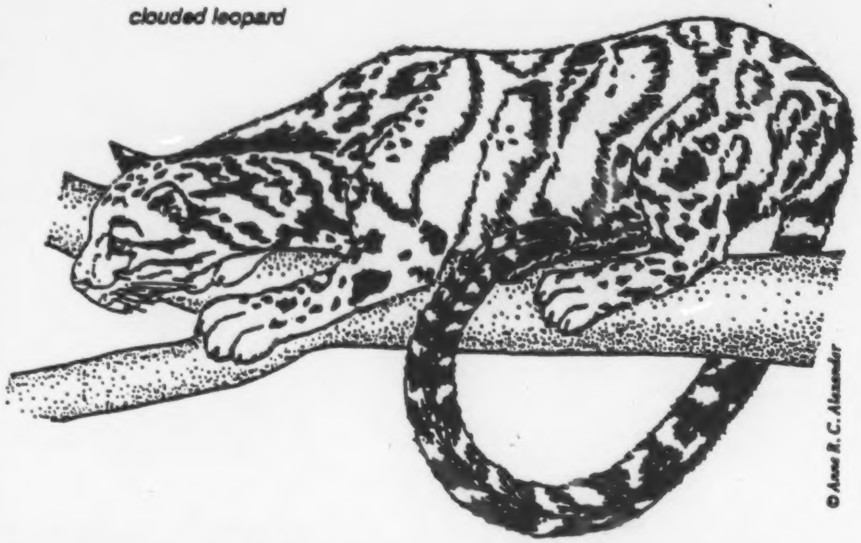
The Diminishing Rain Forests: A Book of Poems, Essays, and Puzzles. Written by 9th grade students from Kings High School in Kings Mills, Ohio, this book describes the destruction of the rain forests and suggests ways to preserve their beauty and genetic diversity. Cost: $1.50 postage and handling. Order from: Ann Haley-Oliphant, Kings High School, 5620 Columbia Rd., Kings Mills, OH 45034.

One Day in the Tropical Rain Forest. Jean Craighead George. 1990. Follow Tepui, an Indian boy, on an unforgettable journey through a wondrous tropical landscape. His adventure takes the reader from a microscopic look at a colony of vicious army ants to a timely overview of the rain forest's vital role in the Earth's ecology. Ages 9-12. Cost: $11.95. Publisher: Thomas Y. Crowell, NY.

Rain Forest Secrets. Arthur Dorros. 1990. In this close-up look at an incredible variety of animals and plants, readers explore the balance of life in the Amazon. Cost: $13.95. Publisher: Scholastic, Inc., NY.

Nature Hide and Seek: Jungles. John Norris Wood, Kevin Dean. 1990. Test your powers of observation. See how many creatures you can find in flip out pages. You'll find a lot of surprises! Answer pages provide information on hidden animals. Cost: $8.95. Publisher: Alfred A. Knopf, NY.

clouded leopard



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The Jungles: A Science Activity Book. A book filled with stickers, puzzles, pictures to color, a world map of jungles, and fascinating facts about animals, plants, and conservation. Cost: $5.95. Publisher: Puffin Books, NY.

Wonders of the Rain Forest. Janet Craig. 1990. An informative and beautifully illustrated book about tropical rain forests. Includes helpful comparisons of tropical and temperate forests. Cost: $2.50. Publisher: Troll Associates, Mahwah, NJ.

Look: The Ultimate Spot-the-Difference Book. April Wilson. 1990. A richly illustrated journey to the far corners of the world, including tropical forests. At first, paired pictures seem identical, but a closer look reveals fascinating differences. Nature notes on answer pages provide lots of information. Cost: $12.95. Publisher: Dial Books for Young Readers, NY.

Articles

"Rain Forests." A classic depiction of life in the rain forest. Article with great pictures. *National Geographic*, Jan 1983, Vol. 163, No. 1.

"Our Steak in the Jungle." Christopher Uhl, Geoffrey Parker. *BioScience*, 1986, Vol. 36, No. 10.

"Brazil." *The Economist*, Apr 25, 1987.

"Rainfall Over the Amazon." Leonora Ko. *Touchstone*, Oct 1989, Vol. 22, No. 1. Publication of UW-Madison's University-Industry Research Program. Scientists study the impact of deforestation on the basin's moisture regime and weather patterns.

"The Monte." Elizabeth Darby Junkin. *Buzzworm*, July/Aug 1990, Vol. II, No. 1. Why the indigenous peoples of the Amazon Basin want to be part of saving the world's largest rain forest.

"Saving Scraps of Rain Forest May Be Pointless, Naturalists Say." James Brooke. *The New York Times*, Nov 14, 1989.

"Ambassador to the Rain Forest." David Quammen. *Outside*, Jan 1989. Tropical ecologist Tom Lovejoy discusses the problems of tropical forest fragmentation (island biogeography) and the hopes of dept-for-nature swaps.

"Trees Fall, Protests Rise Over the Amazon." *Christian Science Monitor*, Sept 22, 23, 26, and 27, 1988. Four-part series.

"Deforestation and international economic development projects in Brazilian Amazonia." Philip M. Fearnside. *Conservation Biology*, Oct 1987, Vol. 1, No. 3.

"Amazon in Peril." *Newsweek*, Jan 30, 1989. Cover article.

"Amazonia—Deforestation and Its Possible Effects." *Interciencia*, Nov-Dec 1989, Vol. 14, No. 6. Entire issue contains papers from symposium on development in the Amazon.

"Ecological Impacts of Selective Logging in the Brazilian Amazon: A Case Study from the Paragominas Region of the State of Para." Christopher Uhl, Ima Célia Guimarães Vieira. *Biotropica*. June 1989, Vol. 21, No. 2.

"Tropical Deforestation." *American Forests*, Nov-Dec 1988, Vol. 94, Nos. 11 & 12. Entire issue devoted to tropical forests.

"Trouble beyond our borders." Craig Thompson. *Wisconsin Natural Resources*, Apr 1989, Vol. 13, No. 2. Shrinking tropical forests place migrating North American birds on a perilous perch.

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"Of Time and the Forest." *Natural History*, Aug 1988, Vol. 97, No. 8. Special 7-part section about the Tongass National Forest in Alaska.

Brochures and Action Guides

Keep Tropical Forests Alive. A free brochure about the importance of saving tropical forests, filled with facts and suggestions for what individuals can do to stop their destruction. Contact: Tropical Forests Project, World Resources Institute, 1735 New York Ave. NW, Washington, DC 20006.

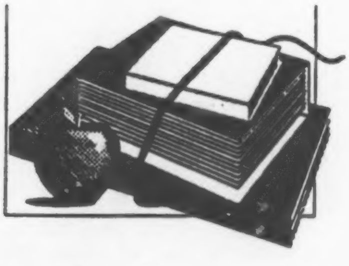
Tropical Forests. A detailed, clear discussion of tropical forest ecology, issues, and solutions to deforestation problems. 48-page booklet. Order from: World Wildlife Fund, 1250 24th St. NW, Washington, DC 20037.

What You Can Do To Save The Tropical Rain Forests. There is hope for stopping the destruction of tropical forests. Find out how you can help. Cost: $1.00. Order from: Sierra Club, Dept. SA, P.O. Box 7959, San Francisco, CA 94120.

Tropical Forest Action Packet. Cost: free. Order from: National Audubon Society, 801 Pennsylvania Ave. SE, Washington, DC 20003, 202-547-9009 (ask for Ken Snyder).

Who's Killing the Forests? A resource and action guide focusing on ancient forest issues. Addresses the problems of forest destruction in both the tropics and the temperate regions of our own United States. Cost: $2.00. Order from: National Audubon Society, 801 Pennsylvania Ave. SE, Washington, DC 20003, 202-547-9009 (ask for Ken Snyder).

Environmental Perspective on America's Forest Products Industries. Order from: American Forest Council, 1250 Connecticut Ave. NW, Washington, DC 20036.



Curriculum Materials

Vanishing Rain Forests. A special EE package to accompany the Smithsonian Institution's Traveling Exhibition Services exhibit, "The Tropical Rain Forest: A Disappearing Treasure." Materials for grades 2-6 include student booklets, posters, a video vividly depicting the rain forest and the problems facing its ecosystems, and a teacher's manual. Cost: $29.95 plus $5.00 postage. Contact: World Wildlife Fund, P.O. Box 4866, Hampden Post Office, Baltimore, MD 21211, or call 301-338-6951.

Wildlife Trade Education Kit. Illegal and excessive trade endangers many species of wildlife. This kit includes a slide program, educator's guide, factsheets, and posters, a brochure, and bumper sticker. Cost: $45.00 plus $2.00 shipping. Order from: World Wildlife Fund, P.O. Box 4866, Hampden Post Office, Baltimore, MD 21211, 301-338-6951.

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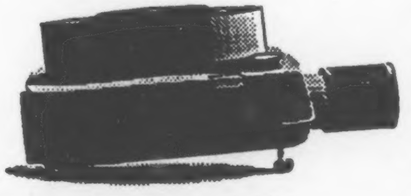
Tropical Rain Forests: A Disappearing Treasure. Teacher manual and student activities from the Smithsonian Institution program. K-12. Order from: SITES, 1100 Jefferson Dr. SW, Room 3146, Washington, DC 20560.

NatureScope: Rain Forests—Tropical Treasures; and Endangered Species. Two excellent K-8 activity books. Cost: $9.25 each. Order from: National Wildlife Federation, 1400 16th St. NW, Washington, DC 20036-2266.

Tropical Forests and the Indiana Connection. A guide designed to relate tropical forest issues to the local level. Developed to supplement educational packets prepared by the Missouri Botanical Gardens for use with the Smithsonian Institution's Traveling Exhibition Service (SITES) exhibit, "Tropical Rain Forests: A Disappearing Treasure." Produced by: Indiana Department of Natural Resources, Division of Forestry, 613 State Office Building, Indianapolis, IN 46204, 317-232-4105.

Rain Forest Packet. Classroom activities for middle school and up. Cost: $10.00. Order from: Global Tomorrow Coalition, 3176 Pullman, Suite 104, Costa Mesa, CA 92626



Audiovisuals

Sounds of a Tropical Rain Forest. 12" record. Cost: $10.95. Order from: Carolina Biological Supply Co., 2700 York Rd., Burlington, NC 27215. Catalog #49-9214.

Sounds of the Jungles: Tropical Rain Forest Vol V. Cost: $11.98. Order from: Nature Recordings Resources, P.O. Box 2749, Friday Harbor, WA 98250.

Mainstreet Wisconsin and the Third World. 23 min. One-sixth of everything Wisconsin manufactures goes to the Third World. Wisconsin's environment is also closely linked (e.g., migratory birds, climate, genetic stock for creating pest resistant crops). This new slide presentation on video depicts the interdependence of Wisconsin and the Third World. Available through interlibrary loan at your public library; for purchase ($15.00) from: UW-Extension Publications, 30 N. Murray St., Rm. 245, Madison, WI 53715; or for rental ($12.50 plus shipping) from: BAVI, Box 2093, Madison, WI 53701, 1-800-363-6888.

The Tropical Rain Forest: Diverse, Delicate, Disappearing. An audiocassette and slide show that examines the complex ecology of tropical wet forests in Latin America, explains the causes and consequences of forest destruction, and suggests what people can do to help preserve the forests. Two-week rental cost: $10.00. Contact: Sierra Club Public Affairs, 730 Polk St., San Francisco, CA 94109, 415-776-2211.

Rain Forest Rap. Video for grades 1-8. Cost: $15.00, plus $2.00 shipping. Order from: World Wildlife Fund, P.O. Box 4866, Hampden Post Office, Baltimore, MD 21211, 301-338-6951. (Or receive it as part of *Vanishing Rain Forests* Education Kit. See Curriculum Materials, below.)

Banking on Disaster. 78 min. A unique and powerful documentary about the disastrous consequences of paving a road through the heart of the world's largest rain forest—the Amazon. It records the effects on the environment and on the people who settled the newly opened land with high hopes, only to see their crops fail. Presented in three parts, to be shown in three class periods. Grades 9-adult. Three-day rental cost: $90.00. Order from: Bullfrog Films, Oley, PA 19547, 1-800-543-FROG.

The Decade of Destruction. A series of five programs about the Amazon, shown on public TV in the fall of 1990. Produced by WGBH, Boston. Titles are: "In the Ashes of the Forest, Part 1 and Part 2," "Killing for Land," "Mountains of Gold," and "The Murder of Chico Mendes." Rental cost: $75.00 each. Distributed by: Bullfrog Films, Oley, PA 19547, 1-800-543-FROG. For program transcripts, write: WGBH, Box 322, Boston, MA 02134. Transcript cost: $5.00 each. Companion book available (see "Books" section above).

Equatorial River: The Amazon. 23 min. Produced by the National Film Board of Canada, this film shows how the water and nutrient cycles work in the Amazon basin and provides a fundamental understanding of the interrelation of elements in this enormous and threatened ecosystem. With teacher's guide. Grades 7-12. Rental: $45.00. Order from: Bullfrog Films, Oley, PA 19547, 1-800-543-FROG.

Wildlife Trade: The Poacher, The Law, and the Consumer. Slideshow about the illicit trade of wildlife. Part of *Wildlife Trade Education Kit.* For details, see "Curriculum Materials" section below.

Tropical Rain Forest. Video for grades 7-12. Rental cost: $10.00. Order from: Sierra Club, Public Affairs, 730 Polk St., San Francisco, CA 94009.

Costa Rican Rainforest. Video with beautiful photography showing the wildlife and forest of Costa Rica. Cost: $26.95. Order from: National Geographic Society, Educational Services, Dept. 89, Washington, DC 20036.

Tropical Rain Forest: A Global Issue. Filmstrip. A good introductory resource. Cost: $22.00. Order from: Appalachian Audubon Society, P.O. Box 15123, Harrisburg, PA 17105.

Our Threatened Heritage. Slide show and script about rain forest issues. Rental cost: $10.00 deposit. Order from: Global Tomorrow Coalition, 25422 Trabuco Rd. #105-44, El Toro, CA 92630.

Into Darkest Borneo. 72 min. A video depicting the story of the hunter-gatherer Penan people and their efforts to save their forest home. Write: Rain Forest Action Network, 300 Broadway #28, San Francisco, CA 94133.

Our Threatened Heritage. 18 min. Video and curriculum booklet about tropical rain forests, their ecology, and reasons why they are threatened. Contact: National Wildlife Federation, 1412 16th St. NW, Washington, DC 20036-2266.

Biodiversity. Video presenting an outstanding overview of biodiversity. Cost: $24.50. Order from: National Academy Press, 2101 Constitution Ave. NW, Washington, DC 20418.

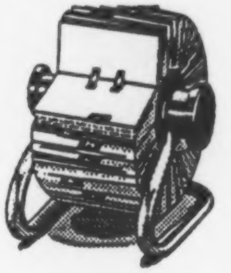
National Geographic Videos. Titles include: *Rain Forest*, a journey to the dense tropical rain forests of Costa Rica; *Land of the Tiger*, a study of the Indian tiger; and *Gorilla*, an informative and engaging look at the mysterious mountain gorilla of central Africa and its endangerment. Distributor: Vestron Video, P.O. Box 4000, Stamford, CT 06907.

Exhibits

Rain Forest: Exploring Life On Earth. Explore the wonderful diversity of life on earth in the Milwaukee Public Museum's two-story rain forest walk-through exhibit. School tours, teacher's workshops, in-service programs, and educational materials and audiovisuals available. Contact: Education Section, Milwaukee Public Museum, 800 W. Wells St., Milwaukee, WI 53233, 414-278-2713.

Tropical Dome, Mitchell Park Conservatory. Houses over 1,000 species of tropical plants, plus live butterflies, birds, reptiles, and amphibians. Self-guided tour focuses on environmental and economic value of plants. Contact: Mitchell Park Conservatory, 524 S. Layton Blvd., Milwaukee, WI 53215, 414-649-9830.

Tropical Rain Forests: A Disappearing Treasure. This traveling exhibit, organized by the Smithsonian Institution Traveling Exhibition Service and the World Wildlife Fund, will be visiting 14 cities through 1994. Midwestern stops: Chicago Botanic Garden, Chicago, IL, January 2-March 28, 1993; Science Museum of Minnesota, St. Paul, MN, May 1-September 6, 1993; and Cleveland Museum of Natural History, Cleveland, OH, October 12-January 4, 1994. For more information, call: 202-357-2700.



Organizations

African Wildlife Foundation, P.O. Box 48177, Nairobi, Kenya.

American Forest Council, 1250 Connecticut Ave., NW, Washington, DC 20036

Amercian Forestry Association, 1516 P St. NW, Washington, DC 20005

The Children's Rainforest, P.O. Box 936, Lewiston, ME 04240.

The Children's Rainforest Project, World Wildlife Fund, 1250 24th St. NW, Washington, DC 20037.

Conservation International, 1015 18th St. NW, Suite 1000, Washington, DC 20036.

Cultural Survival, 11 Divinity Ave., Cambridge, MA 02138.

Environmental Defense Fund, 257 Park Ave. S, New York, NY 10010.

Friends of the Earth/United Kingdom, 2628 Underwood St., London, N17JU, UK.

Global Tomorrow Coalition, 1325 G St. NW, Suite 915, Washington, DC 20005.

International Union for the Conservation of Nature and Natural Resources (IUCN), Avenue Mont Blanc, 1196 Gland, Switzerland.

Missouri Botanical Gardens, P.O. Box 299, St. Louis, MO 63166.

The Monteverde Conservation League, Apartado 10165, San Jose, Costa Rica (see article in Fall 1990 *EE News*).

National Audubon Society, 801 Pennsylvania Ave. SE, Washington, DC 20003.

National Forest Products Association, 1250 Connecticut Ave. NW, Washington, DC 20036

National Wildlife Federation, 1412 16th St. NW, Washington, DC 20036-2266.

National Zoological Park/Smithsonian Institution, Washington, DC 20008.

The Nature Conservancy, 1815 N. Lynn St., Arlington, VA 22209.

Programme for Belize, P.O. Box 385 Q, Vineyard Haven, MA 02568.

Rainforest Action Network, 301 Broadway, Suite A, San Francisco, CA 94133.

Rainforest Alliance, 270 Lafayette St., Suite 512, New York, NY 10012.

Resources for the Future, 1616 P St. NW, Washington, DC 20036

Save the Rainforest, Science Dept., Dodgeville High School, 912 W. Chapel, Dodgeville, WI 53533.

Smithsonian Tropical Research Institute, APO Miami, FL 34002-0011.

Society of American Foresters, 5400 Grosvenor La., Bethesda, MD 20814-2198.

U.S. Forest Service, PO Box 96090, Washington, DC 20013-6090.

The Wilderness Society, 1400 Eye St. NW, Washington, DC 20005.

Wildlife Conservation International, New York Zoological Society, Bronx, NY 10460.

World Resources Institute, Tropical Forests Project, 1735 New York Ave. NW, Washington, DC 20006.

World Wildlife Fund/Conservation Foundation, 1250 24th St. NW, Washington, DC 20037.

World Wildlife Fund/United Kingdom, Panda House, Godalming, Surrey, GU7 IXR, UK.

—Most of these organizations provide classroom materials, resource lists, and suggestions for what you can do.

AN INTRODUCTION TO MUNICIPAL SOLID WASTE MANAGEMENT

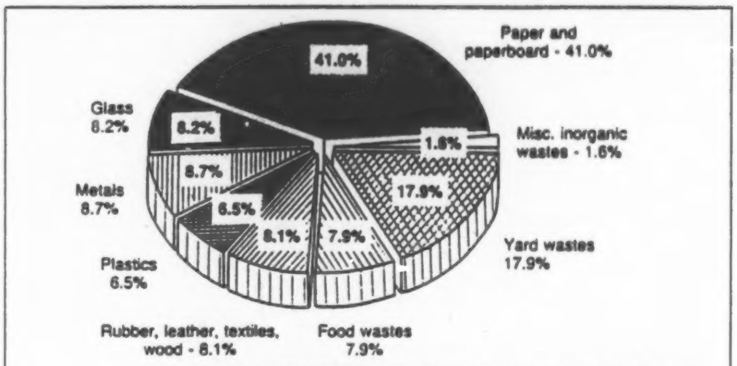
This issue of Focus is the first in a bi-monthly series on current topics relating to municipal solid waste management. Focus is published by the Keep America Beautiful, Inc. Solid Waste Task Force.

On average, every American "throws away" 3 1/2 pounds of municipal solid waste (MSW) a day. This figure is determined by dividing 160 million tons, the estimated amount of waste generated on an annual basis in the United States, by the total population. As the population increases, this amount is expected to expand to 193 million tons by the year 2000. It is important to remember that these quantities are estimates. While the true amount of waste may be more or less, estimates are useful tools in developing strategies to handle solid waste.

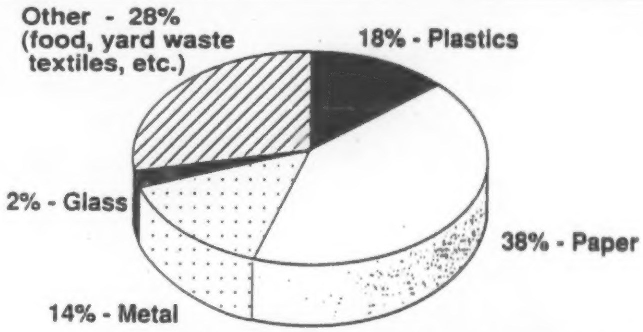
MSW consists of wastes from households, commercial establishments, institutions, light industry, and small quantities of special wastes such as from hospitals and laboratories.

COMPOSITION OF WASTE

The components of the waste stream have been analyzed by both their weight and volume as the charts above demonstrate. These charts serve as guides for the composition of waste. However, waste composition varies with type and size of each community, climate, and time of year.



GROSS DISCARDS, BY WEIGHT, OF MSW MATERIALS, 1986
Source: Characterization of Municipal Solid Waste in the United States, 1960 to 2000; Franklin Associates, Ltd., 3/30/88.
Prepared for the U.S. Environmental Protection Agency.



GROSS DISCARDS, BY VOLUME, OF MSW MATERIALS, 1986
Source: Estimates of the Volume of Municipal Solid Waste and Selected Components; Franklin Associates, Ltd., 10/19/89.
Prepared for the Council for Solid Waste Solutions.

MEANS OF SOLID WASTE DISPOSAL

Historically, MSW has been disposed of in landfills; it was inexpensive, and large parcels of land were relatively easy to acquire. Today, landfills are closing at a rapid pace because they have filled up or were not constructed to meet current stringent environmental regulations. In 1986, there were approximately 6,000 operating landfills. By 1991, the U.S. EPA says that 45% will be closed leaving just 3,300 sanitary landfills remaining in operation.

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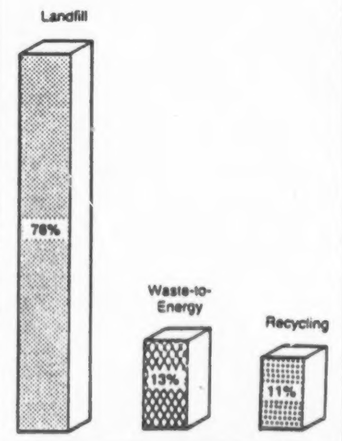
These closures, coupled with the increasingly difficult task of siting new facilities due to citizen opposition, signal that we can no longer depend on landfilling the vast majority of our MSW.

Following is the manner in which MSW was disposed in 1989:



How America Disposes of its MSW, 1989.

As the quantity of our MSW grows, concern for its safe and efficient disposal has grown, too. Effective waste management requires an integrated approach — the consideration of a number of technologies working compatibly — including source reduction, recycling, composting, waste-to-energy, and sanitary landfill.

These alternatives can and will assist in managing waste but they are interdependent, not independent options. Utilizing the integrated approach does not mean that all of these options must be implemented, rather it presents a menu which every community should consider when choosing the proper combination. Communities vary in population, geology, composition of the waste stream, availability of markets for recyclable materials, etc.; these factorswill affect the mix of disposal options chosen by each community.

SOURCE REDUCTION:
Reducing the amount of waste produced is the first step in easing the nation's solid waste disposal problem. Responsibility for this function falls on manufacturers and consumers alike. The U.S. EPA defines source reduction as reducing the volume of material that must be discarded, minimizing toxic substances in products, and manufacturing products with longer, more useful lives. There are numerous actions citizens can take to reduce waste such as: use both sides of a sheet of paper, purchase packaged products in larger containers which result in less packaging for disposal, and repair broken appliances instead of throwing them away.

RECYCLING:
Collection, separation, preparing to buyer's specifications (including cleaning and separating materials, removing labels, baling, etc.), sale to markets, processing and eventual reuse of materials are the steps in the recycling loop. Glass, aluminum, paper, steel, plastic, scrap tires and used oil are all recyclable materials. Provided that there are viable and stable markets for the materials, they can be diverted from the waste stream to reduce the ultimate burden of disposal. Note: states and communities that have mandated recycling have only mandated collection of recyclable materials. Many are now experiencing difficulty in finding markets for the collected materials, especially newspapers.

COMPOSTING:
Often considered part of the recycling loop, composting of yard waste (grass, leaves, and brush) can transform a significant section of the waste stream into a useful soil additive or mulch. Several states and communities are banning yard waste from landfills, requiring municipalities to operate their own compost programs. Many homeowners have compost piles in their backyards; some add kitchen scraps to these piles. Home composting of food waste must be carefully controlled. If a temperature of 131 degrees Fahrenheit is not achieved and sustained for several days, these piles can breed bacteria and attract rodents.

WASTE-TO-ENERGY:
MSW brought to a waste-to-energy facility is either burned as received (mass burning) or, may be processed to remove noncombustible materials to produce a more uniform fuel (refuse-derived fuel). These facilities can reduce the volume of MSW by 60-90% while generating steam or electricity. Emission controls eliminate air pollution; and the ash, disposed of in a properly designed and operated landfill, does not pose a threat to groundwater.

SANITARY LANDFILL:
The common factor to all of the alternatives, sanitary landfills will always be needed to dispose of nonrecyclable items, ash from waste-to-energy plants, and residue from processing of recyclable materials. Modern landfills are not simply "dumps." They are equipped with liners, leachate collection and monitoring systems, and methane gas controls. Presently, 77 sanitary landfills capture the methane to produce energy. ☐

Degradability will be the subject of the next issue of Focus, to be published in February, 1990.

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DEGRADABLE PLASTICS: MYTH OR MIRACLE?

In recent years the issue of degradability has come to the forefront as consumers, corporations, and legislators seek methods to solve the nation's solid waste management dilemma. Vast quantities of legislation–300 pieces during 1989 alone–have been introduced at the local, state, and federal levels mandating the use of recyclable or degradable packaging material. Consumers, anxious to make a meaningful contribution to reducing their community's waste management problems, are demanding degradable plastic products at the checkout line.

Yet there is virtually no research demonstrating that degradable products are useful or environmentally safe. To slow the rush towards this unproven technology, a number of environmental organizations called for a boycott of degradable plastic products in December, 1989. The resulting dichotomy–environmental groups versus consumers and legislators–has served to confuse nearly everyone as well-intentioned factions debate the merits of degradable products.

To make informed decisions, it is first necessary to understand the two major degradable processes, biodegradation and photodegradation.

Biodegradation

Biodegradation is a process wherein micro-organisms secrete enzymes to chemically break down material that they then eat. This can be in the presence of oxygen (e.g. composting) or in the absence of oxygen (e.g. in a landfill). In either case, there must be moisture present and other conditions must be met. The biodegradability of certain plastic products (those in sheet form, such as bags and the plastic backing of disposable diapers) can be enhanced by manufacturing them with additives such as a small percentage of corn starch or vegetable oil.

Photodegradation

Photodegradable plastics are materials which break down in sunlight. The sun's ultraviolet radiation attacks a weak link in the molecular structure of the plastic. The breaking of this link weakens the plastic and causes it to fragment. Virtually all plastic products are photodegradable over an extended period of time (even decades or longer). The process can be enhanced in many common plastics by the use of additives, such as certain metal salts, or by altering the molecular structure.

The effect of either degradation process on landfill capacity, litter, marine animals, and other wildlife is unknown. The State University of New York at Stony Brook, among others, is conducting studies to determine the rate and extent of degradation of corn-based plastics.

In the University's Fall 1989 publication, *Waste Management Research Report*, researchers Vincent Breslin and Sheldon Reaven state, "The rate and extent of degradation of cornstarch based plastics when they enter the environment are not well known now." Questions being investigated include health and environmental risks associated with degradable plastics (e.g., from plastic dust or from leachate);

CINCINNATI
Contest For

Excavations of sanitary landfills across America have shown that sufficient moisture does not exist for effective biodegradation of organic matter–the newspaper above was dug up intact after being buried for 10 years.

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how the wider use of degradable plastic will affect plastics recycling (especially commingled); and how landfill waste volumes might be affected. The article concludes, "The controversy over the use of biodegradable plastic versus non-degradable plastic will undoubtedly continue as long as these questions remain unanswered."

The lack of uniform definitions for degradable plastics is also an obstacle. Some legislation has mandated that plastics degrade in 90 days, without evidence that is it technically feasible or what the standard is to determine that the plastic has degraded. Others have not required that the product degrade in a certain time, but just that it be degradable, even if it takes 10 years or more.

Following are the most frequently discussed and misunderstood points relating to bio/photodegradable plastic products.

LANDFILL:

Degradable plastics are often touted as solutions to rapidly filling landfills. Sixty-five percent of the material entering landfills is considered degradable (i.e., yard and food waste, paper products). Yet there is little research to show that degradable plastic or any other material actually breaks down rapidly in a landfill. Most modern sanitary landfills are constructed to inhibit degradation by keeping moisture out of the waste to retard the generation of "leachate," a liquid formed from precipitation percolating through the waste. Uncontrolled leachate can contaminate ground and surface water. Degradation in a landfill also produces methane gas, which must be managed.

Excavations of landfills by Dr. William Rathje, Professor of Archaeology at the University of Arizona, have shown organic matter such as food and yard waste completely intact after 10 to 20 years of burial. Discussing corn starch biodegradable plastics at Keep America Beautiful, Inc.'s 36th Annual Meeting, Dr. Rathje stated, "If the 'bugs' aren't going to eat corn on the cob, they're certainly not going to eat corn in the plastic."

Photodegradable plastics require sunlight in order to degrade. Sunlight certainly is not available within the depths of a sanitary landfill, so photodegradable plastic will not have a beneficial impact on reducing the volume of buried waste.

RECYCLING:

There are concerns that degradable plastics that get mixed into batches of plastic intended for recycling may adversely affect the final product. Recycled plastics may be turned into such durable products as lumber for decking, benches, and piers. Contaminating batches with degradable polymers may compromise the quality of the end product and undermine the efforts to recycle plastics on a widespread basis.

ROADSIDE LITTER:

Many legislators and well-intentioned individuals who understand that bio/photodegradability will not save room in landfills do, however, believe that degradable plastics will ease the litter problem.

With 37 years of experience in litter prevention, Keep America Beautiful, Inc. has proved repeatedly that litter is a behavioral problem and is eliminated only when this behavior is changed. KAB research shows that people litter where litter has already accumulated. If individuals are given the sense that plastic waste dumped on the roadside will disappear quickly in sunlight, not only will that trash spoil the landscape for months, but at the same time it will attract even more litter as the degradation process slowly occurs.

MARINE DEBRIS:

Many believe that photodegradable plastics also will solve the problem of plastic waste in the marine environment. The problems associated with plastic in the ocean are particularly tragic–the entanglement of birds and other animals in six-pack rings and plastic fishing net and the ingestion of plastic by marine life. Like litter, marine debris is caused by the improper disposal of trash in waterways. Experts at the Center for Marine Conservation state that as plastic photodegrades it may reduce the entanglement of marine life, but it will increase their ingestion of plastic material. As the plastic breaks down into small pieces, a larger portion of the food chain may ingest the material. Also, since photodegradation does require time, the potential for entanglement exists even with photodegradable plastics. Only when plastic is kept out of the marine environment is the problem solved.

POTENTIAL USE:

Keeping all of these concerns in mind, it is still too soon to close the door on "degradable" technology. As the processes are refined, and research is documented, biodegradable plastic bags for collecting yard waste may be useful in municipal composting operations. Composting, unlike sanitary landfilling, is a process to encourage degradation, and requires moisture and air for the necessary micro-organisms to flourish. Because compost may be used for the production of food crops, the health risks associated with biodegradable plastics must be answered before the end product can be accepted. Agricultural mulch films, used by farmers and gardeners to reduce weeds and loss of fertilizer, present another potential market for degradable technology, given satisfactory results from continuing research.

Further information on degradable plastics is contained in the U.S. E.P.A.'s Report to Congress: *Methods to Manage & Control Plastic Wastes*. (EPA/530-SW-89-051A) A free executive summary and order information can be obtained by calling the RCRA Hotline: 1-800-424-9346.

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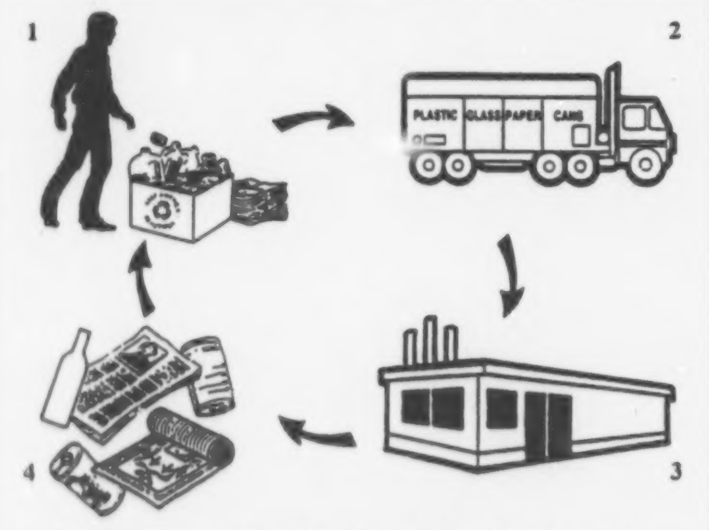
MARKETING RECYCLABLES

When implementing a recycling program, whether community-wide or at an office building, the most important thing to plan for is the markets to which the collected recyclables will be sold. Reasonable assurance that markets for the recovered materials exist, before collecting them, is a necessity. Otherwise, collection efforts will result in nothing more than the landfilling of separated trash. Contrary to public perception, recycling involves more than the collection of material; recycling occurs when the collected materials are sold to manufacturers for reprocessing into a usable product, returned to the marketplace, and purchased for use.



Recycling occurs when materials are separated from other solid waste (1), collected and sold to manufacturers (2), reprocessed into new products (3), returned to the marketplace, and purchased for use (4).

Before beginning a collection program, take time to carefully study the materials markets. For a municipal program, taking as long as one year to find markets, develop a relationship, and sign a contract is not uncommon. Remember, a recycling program is a competitive business operation, the collected recyclables are commodities, and markets often fluctuate with the economy. For those new to the recycling industry, look for a mentor who is familiar with the complexities of the field.

Determining the goals and purpose of a collection program, prior to contacting markets, is useful in determining the feasibility of the program. Is the program's goal to make money, reduce landfill space, or simply be a good citizen? Will it be possible to operate on a break-even basis? In some regions, the sale of recyclables will not cover operating costs, so collecting recyclables may not be a good way to raise funds for a local charity. Alternatively, the cost avoidance associated with recycling, rather than landfilling or incinerating material, may make it an economical option for local government. Diverting material for recycling extends the life of a landfill – an important consideration as these facilities become increasingly expensive and difficult to site.

Following are recommendations for marketing your post-consumer recyclables:

Consistently high quality and quantity will enhance the ability to secure long-term commitments from markets. Most materials are worth considerably more if kept separate, but always check with local markets. Often, guarantees are required for collecting and delivering a certain tonnage of material on a regular basis. Generally, the more material collected, the better the chances are for getting a fair price.

Don't sell garbage. Recycling programs collect a raw material for use by manufacturers; therefore quality is most important. Contaminants such as ceramic material in glass, excessive moisture in used beverage cans, or paper touched by food can ruin the entire batch of recyclables. As an example

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a piece of ceramic the size of a quarter will break into 10,000 pieces and contaminate an entire truckload of glass!

The best place to begin the search for markets is the local yellow pages. Check under "scrap" or "wastepaper" dealers and "recycling." Industry trade associations and state agencies also develop lists of materials buyers. Additionally, several helpful guides are available for purchase. For example. *American Recycling Markets* ($105.00), published by Recoup Publishing Limited, lists 15,000 companies, agencies, and recyclers. Information can be obtained by writing P.O. Box 577, Ogdensburgh, NY 13699 or by calling (800) 267-0707.

Conduct a market survey. Locate users of materials you plan to collect within a certain radius. Become familiar with local industry and the ability of known recycling plants to process materials to market specifications, such as baling paper, crushing glass containers, or flattening cans.

Work with local markets, if possible. Even if the price offered is lower than that of a dealer in the next county, transportation and communication savings may offset the difference. Therefore, it is important to compare net, rather than gross selling prices. One KAB coordinator reports that it costs between $1.00 and $1.20 per mile to deliver a 20-ton truckload of recyclables to their markets. This expenditure eats directly into profits.

Estimate quantities of material to be collected and put out a request for proposals (RFP). Then begin the negotiation process. Negotiable items include freight, collection containers, allowable levels of contaminants, method and time of payment, and length of contract. Contracts can protect both buyers and sellers against severe fluctuations by establishing a floor price when the market is down, and a discount when the market is up.

When collecting sufficient quantities of material, selling them directly to manufacturers or mills may be possible. Scrap processors and dealers act as middlemen and purchase material from many sources. Many times a higher price can be commanded if recycled materials are sold straight to a mill. However, there is always a risk that the mill will go on strike or perhaps shut down. The size of the program will dictate the marketing of the material.

Talk with several companies before making any commitments. In a multi-material collection program, working with a number of materials buyers is likely.

Get the facts. Clearly understand the responsibilities borne by the dealer and the program operator. Include them in the contract. Understand the vendors' specifications: should glass be color separated and crushed, may magazines be mixed with newsprint? Specifications will determine what type of equipment you may need to purchase, such as balers or shredders.

Network with surrounding communities to learn about potential markets. Consider cooperative marketing with surrounding areas if your volumes are not high enough to demand competitive prices.

It is important to deal with reputable materials users. Companies with established track records are the safest. If negotiations are being held with a small company, or one that is unfamiliar, it pays to carefully check their background. Established firms will often provide technical assistance, keep customers apprised of market fluctuations, as well as cyclical downturns and upswings, and adjust prices accordingly.

Beware of dealers that do not make regular pick-ups, dispute tonnage, or fail to make timely payments. Cash flow is a very important consideration for fledgling operations.

Develop long-term relationships with buyers. For example, it is not advisable to switch to a new wastepaper dealer just because they are offering $1.00 more a ton than the recycler you have been dealing with for the last several years. If there is a market downturn, the steady buyer will be more inclined to stand by you, if you stand by him.

Beware of price optimism. When checking published lists of prices paid for recyclables, realize that it is not possible to earn that much on a long term basis. Spot prices do not accurately reflect the prices earned in exchange for a long term contract. Nevertheless, it is a good idea to regularly monitor market prices to make sure the price is in the ballpark. *Recycling Times*, published bi-weekly by the National Solid Wastes Management Association in Washington, D.C. is a good source.

Expenses may exceed income, particularly with a curbside program. However, the avoided cost of not landfilling or incinerating material will likely result in significant savings.

Be flexible. If the market collapses, look to other management alternatives. For example, if it is impossible to sell newsprint to a paper dealer or mill, perhaps it can be sold for use as animal bedding or cellulose insulation.

Close the loop. The best way to sustain and strengthen recycling is to purchase products made with recycled material.

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COMPOSTING

The latest calculations from the U.S. Environmental Protection Agency indicate that the amount of municipal solid waste (MSW) generated annually in the United States is approximately 180 million tons. The safe and efficient management of this ever-increasing quantity calls for creative, multi-pronged approaches. Composting is one approach that is being used to manage some of the organic components in MSW.

Composting is the aerobic (oxygen-dependent) biological process by which plant and other organic materials decompose under controlled conditions. The finished product is a dark-brown substance referred to as stabilized compost or humus. Contrary to popular opinion, this type of compost does not contain enough nutrients to be a fertilizer. However, it is a soil amendment that improves texture and aeration, increases the soil's ability to retain water, decreases erosion, and moderates soil temperature.

For decades, individuals and select municipalities have composted yard waste and some food scraps using a simple technique of wetting and turning the matter periodically until is is transformed into a composted humus product.

Today, this simple method is being augmented by more technologically advanced composting operations to divert an increasing amount of organic materials from landfills and waste-to-energy incinerators. Composting can play a significant role in integrated solid waste management in combination with one or more of the following: source reduction, recycling, waste-to-energy, and sanitary landfill. The EPA reports that as a result of the composting process, organic wastes can be reduced 50 to 85%.

BACKYARD COMPOSTING

Homeowners with a significant amount of property often set aside an area for a compost pile. Generally, leaves, grass clippings, small brush and vegetable peelings can be composted in backyards. *Citizens must be aware of the health problems associated with composting food wastes in their backyards.* Discarded food may attract rodents and pets; meat and dairy products can breed pathogens that may contaminate the resulting compost product.

Common methods for composting in the backyard include the use of windrows, cylindrical pens made with chicken wire, wooden bins, and perforated steel drums. Windrows are elongated piles turned periodically to expose the material to air. During rainy seasons, windrows may have to be covered to prevent excessive moisture. When compost piles get too wet, air is unable to permeate the material and anaerobic conditions (without oxygen) will result in odor and slower decomposition.

CENTRALIZED YARD WASTE COMPOSTING

Recognizing that, on average, yard waste accounts for 18% of the municipal solid waste stream by weight, several states have imposed bans on its disposal at landfills and waste-to-energy facilities thereby forcing local governments to develop municipal yard waste composting programs to manage this waste component. According to *BioCycle* magazine, municipal yard waste composting grew from 651 to 986 programs between 1988 and 1989.

It is important to understand the financial obligations associated with a centralized composting program. Costs include: land and site preparation, environmental controls, collection, transportation, processing, and marketing costs. Revenues from the sale of compost are not likely to cover the cost of collecting, transporting, processing and distributing the material. In some cases communities will have to pay to have the compost spread. But in areas where landfill space is scarce or waste-to-energy is employed, composting can represent an appropriate alternative when properly integrated within the community's waste management system.

Rutgers University has identified four technology levels from which communities may choose when implementing a municipal yard waste composting program:

Minimal: The formation of large windrows, 12 feet high by 24 feet wide and up to several hundred feet long, is the least expensive method for composting. The minimal approach calls for the windrows to be turned with a front-end loader as infrequently as once a year. Material is usually suitable for use as compost after one to three years. Although relatively inexpensive and requiring little attention, minimal composting technology calls for a large buffer zone between the facility and neighboring residents due to considerable odor resulting from the infrequent turning.

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Low-level: Smaller windrows and more frequent turning limit odor problems with this approach. Windrows are piled 6 feet high by 12-14 feet wide. After the first burst of microbial activity (one month), two piles can be combined. Approximately one year later, after several windrow turnings, piles can be moved off the working area to cure, opening up room for fresh yard waste. This approach turns yard waste into compost in approximately 16-18 months. Low-level technology is less malodorous because the material is turned more frequently; therefore the buffer zone does not have to be as wide.

Intermediate-level: This process is similar to the low-level technology, but weekly turning of the windrows is employed to accelerate decomposition. Compost may be ready in four to six months. Extra processing inherently means an increase in capital and operating costs; and the use of specialized windrow turning machines, rather than front-end loaders, is more expensive. Intermediate technology is attractive for large facilities attempting to divert as much yard waste from landfills as possible.

High-level: Also referred to as *forced aeration*, high-level technology utilizes an automated blower system for temperature and moisture control. Air is blown through a network of perforated plastic pipes under the compost pile. More expensive than windrow turning, high-level technology is most commonly used for co-composting sludge with yard waste or other bulking agents where aeration and temperature control are even more important.

As with recycling, end markets are integral to the success of a municipal composting program. Most programs depend on end uses within a community. Landscapers, parks departments, nurseries, and residents all represent potential users of a quality compost product. Compost can also be blended with soil and used as daily cover at sanitary landfills.

MUNICIPAL SOLID WASTE COMPOSTING

MSW composting provides a means of converting a significant portion of organic materials into a humus-like product. Presently, MSW composting technology targets up to two-thirds of the solid waste stream composed of food, paper and yard wastes. Extensive source separation and pre-processing are required to remove "recyclables" and "noncompostables." Both manual and mechanical separation are needed to remove bulky materials, metals, glass, plastics, and household hazardous wastes from the desirable compost material.

MSW composting is a process which often requires sophisticated technology. "In-vessel" systems consist of large, enclosed chambers in which the composting process is accelerated. Material is digested from two to 28 days (depending in part on the design of the vessel), and curing takes another four weeks. After the initial digestion period, the material is stabilized in piles or windrows. If a conventional, low-level windrow system is used, the composting process could take twice as long.

Marketing MSW compost may be more difficult than yard waste compost because of the greater potential for product contamination. If not properly managed, MSW compost is more likely to be contaminated by heavy metals, household hazardous waste, small-quantity-generator hazardous wastes, and industrial sludges/process waste. Thorough source separation and pre- and post-processing can help remove some of these contaminants. While it may not always meet state government standards for use on food crops, MSW compost may be used for land reclamation and by landscapers, parks departments, nurseries and residents.

CO-COMPOSTING

Co-composting refers to the simultaneous composting of two or more diverse organic waste streams, one of which is likely to be municipal sewage sludge. Sludge provides moisture and nutrients to the compost while MSW, yard waste, sawdust or wood chips often act as bulking agents, adding porosity and absorbing water. Windrows, in-vessel systems, and static piles using perforated pipes or blowers are all techniques that can be used in co-composting.

To protect against run-off into surface or ground water, co-composting is usually conducted on a concrete pad or in an enclosed area, similar to an in-vessel system.

The resulting product, a valuable soil additive, can be high in nitrogen, phosphorus, potasium, and other nutrients. If the sewage sludges are not heavily contaminated with heavy metals or other toxic substances, they can greatly increase crop yield.

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The KAB Solid Waste Task Force extends a special thanks to the following people for providing comments on earlier drafts of this document:

Charles Cannon, Executive Vice President, The Solid Waste Composting Council.
Richard Kashmanian, Ph.D., Senior Economist, Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency.

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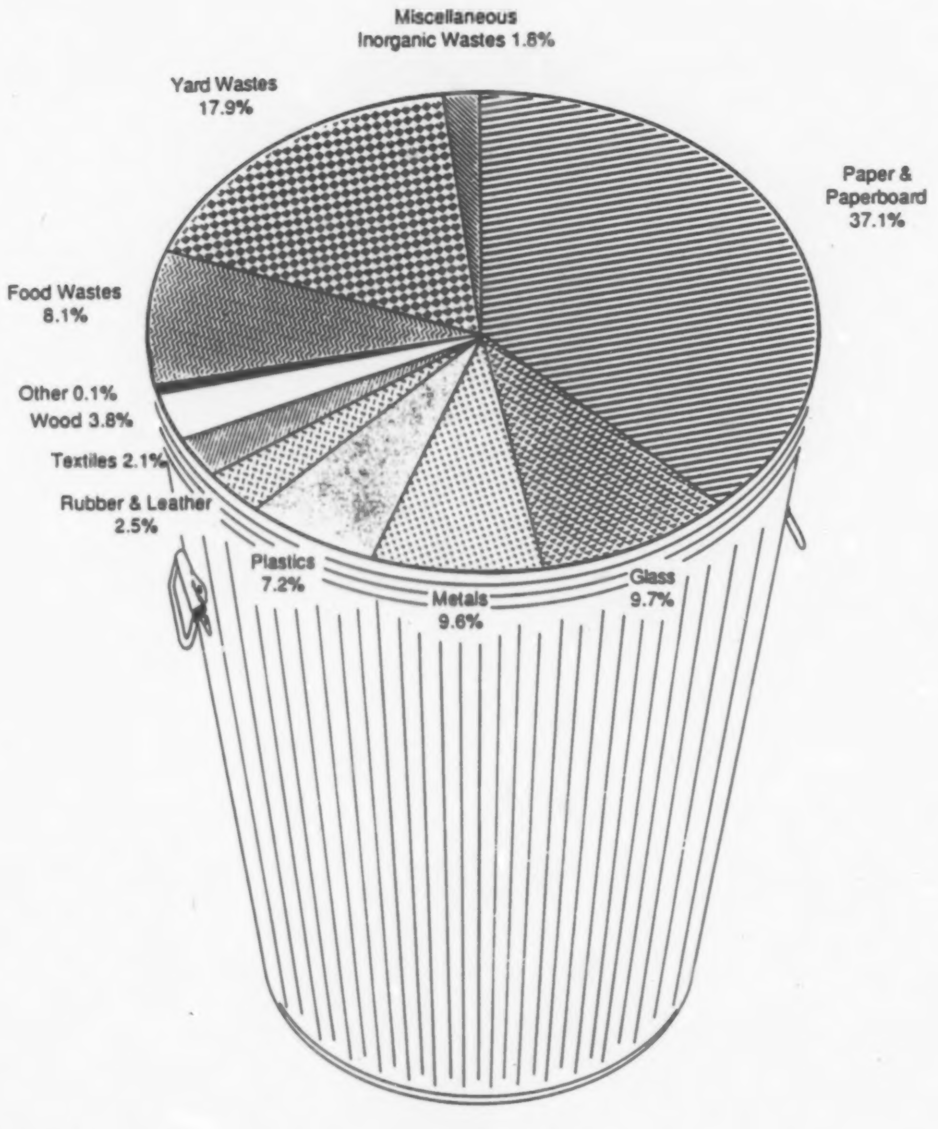
Materials Discarded Into The Municipal Waste Stream



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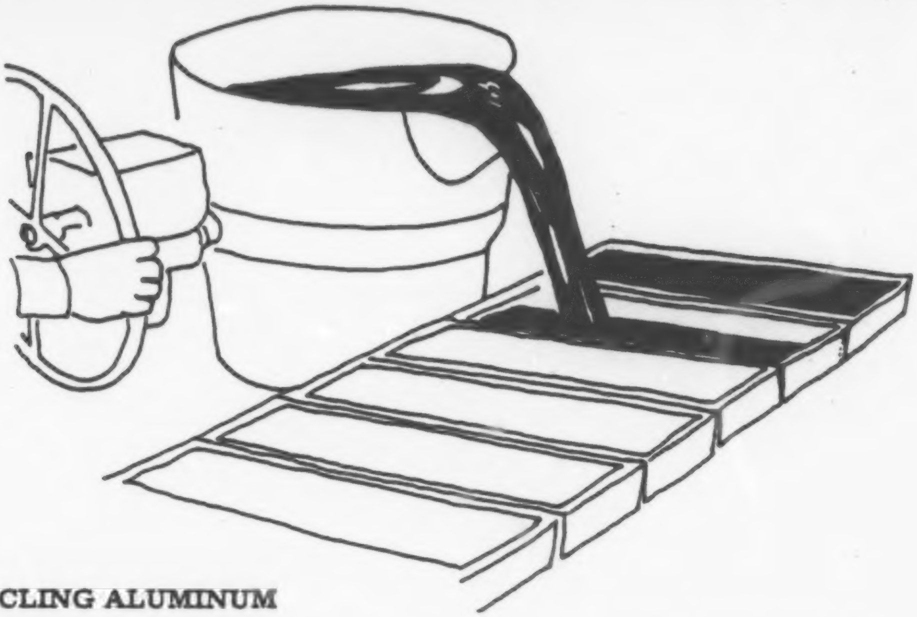

RECYCLING ALUMINUM

Recycling aluminum is profitable because less energy is used to melt and mold used aluminum than manufacturing new aluminum. Also bauxite, an expensive import, is a virgin material required in the manufacturing of new aluminum.

Smelters receive their aluminum ONLY from scrap dealers; recycling centers serve as collection points for scrap dealers. Smelters must chemically analyze all aluminum they purchase because aluminum contains different alloys in various amounts and the orders for the processed aluminum have different alloy requirements.

Aluminum smelters produce aluminum ingots according to alloy requirements made by the manufacturers of aluminum products who purchase the ingots. The ingots are made by pouring molten aluminum into molds and allowing it to cool.

After the used aluminum is purchased from a scrap dealer the process of recycling the aluminum includes:

A. The scrap aluminum is shredded and decontaminated. Steel is removed from the shredded aluminum as it passes over magnetized conveyor belts.

B. Furnaces melt the aluminum for 18 hours, with flux, which separates impurities which are skimmed off periodically.

C. Molten aluminum is poured into molds, cooled for 24 hours, banded into one ton bundles and labeled according to alloy contents, then sold to manufacturers of aluminum products. The manufacturers may hot-roll the ingots into strip aluminum.

Ferrous and other metallic materials constituting more than 1% of the molten aluminum renders the batch unusable. Extra precautions must be made to ensure no bimetal containers are combined with the aluminum containers. This can be done by checking each can with a magnet.

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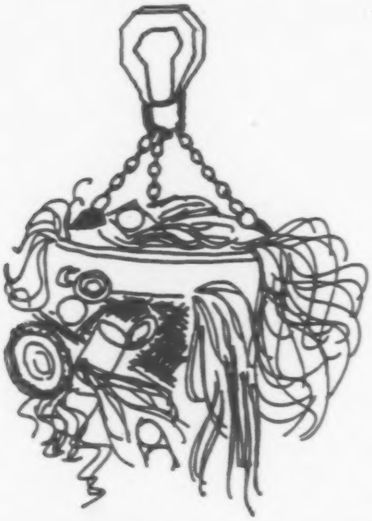
RECYCLING TIN CANS

The expense of importing tin makes the detinning process required to recycle tin cans less expensive than using virgin tin.

Tin cans are sheet steel plated with tin to deter oxidization. Recycling tin cans involves separating the tin from the steel, then reusing both the tin and steel.

The separating process involves the following:

A. Usually a magnet is used to lift and deposit tin coated steel into tanks which contain a lye(alkaline) solution heated to about 200° F. The tin comes off the steel and becomes part of the lye solution. Thick tin coatings, paint etc., cause the detinning process to take a longer time.



B. The cans are removed and rinsed to recover all the lye-tin solution, then baled and sold as scrap steel.

C. The lye-tin solution is put into troughs where chain cathodes collect the tin through electrolysis. When all tin has been removed from the solution the cathodes are placed into vats of molten tin (from previous batches). Here the tin melts off the cathodes into the vat.

D. The tin goes through a refining process which makes the tin 99.9% pure in about 36 hours.

E. The refined tin is poured into 100 pound molds and cooled. The refined tin can be used to coat cans or manufacture chemicals used in perfumes, soaps and blueprint paper.

F. The lye solution is filtered and used again in the detinning process.

G. The scrap steel cans are "melted" and used with iron ore (new steel) or alone to make slabs of steel or structural steel which can be turned into cans or other products.

Since paper on cans does not dissolve, it delays the stripping process and prevents the recovery of tin from the lye solution. Aluminum reacts chemically with the alkaline solution: causing it to lose its stripping capabilities. Cans without ends removed can trap the solution, causing it to be wasted. Shredded tin cans make for a full recovery of tin plating.

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RECYCLING PAPER

Both trees and energy are saved when paper is recycled. Using 100% recycled paper in the manufacturing of new paper products is more cost-effective than combining virgin materials with recycled paper. however. the 100% recycled paper is usually not acceptable as writing paper.

Paper is manufactured by bonding together tiny wood fibers with heat to make a continuous sheet of paper. The wood fibers must be retrieved from used paper products to be used in new paper products. The longer the wood fibers the better the "grade" or quality of paper.

The process of retrieving wood fibers from used paper products includes:

A. Used paper is deposited in a pulper (giant mix master which is continually filled with water. with a rotor in the middle and a sieve at the bottom). The rotor forces the water and paper to mix. breaking the paper into wood fibers. The water and fibers go through the sieve. About 10% of the used wood fibers are lost because they are too short.

B. The pulping process creates paper stock of 98% water and 2% paper fibers. The paper fibers are picked up from the water by heated cylinders which turn in a trough filled with paper stock. The cyclinders deposit fibers onto a belt. matting them together until the desired thickness of paper is obtained.

C. The wet sheet of paper passes over drying cylinders. becoming a sheet of new paper. The new paper will be off-white or have tiny colored fiber flakes. Virgin wood fibers can be combined with recycled paper fibers to make a higher quality paper.

Plastic. wax. non-water soluble glue. carbon. etc.. clog the sieve of the rotor. Care must be taken in sorting paper items for recycling to be sure these items are not included.

Stables and paper clips can be scraped off the sieve without dismanteling the rotor. consequently these items are not as hazardous to the recycling process although they should be removed.

RECYCLING GLASS

Using recycled glass to create new glass containers saves energy through permitting the furnace temperature to be lowered 10°F for each 10% of cullet (see recycling vocabulary) used in the mixture. Raw materials of sand. limestone and soda ash are also saved by using recycled glass.

Glass containers are manufactured by pouring molten glass into molds. Molten glass can be up to 83% recycled glass without affecting the quality of the glass.

The process of using recycled glass to create new glass includes:

A. Used glass is crushed into ½ - 1 inch pieces and passed over a magnetized conveyor belt to remove ferrous metal. This is done in a batch house with the end product being cullet.

B. Cullet is heated with raw materials and melted into molten glass.

C. The molten glass goes through feeders to forming machines where globs are dropped onto molds. The mouths of the containers are made first. with air pressure and a second mold used to create the base.

D. Containers are delivered to food processors etc.. labeled and filled.

Aluminum. stones and dirt which cannot be removed from cullet with the magnetized conveyor belt cause weak spots or flaws in glass. It is very time consuming for glass manufacturers to separate the contaminants from the glass. consequently they may not use such glass and discontinue to purchase glass from dealers who sell them contaminated glass. Paper. however. is easily burned in the furnaces which melt the glass. therefore it does not need to be as carefully removed.

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RESOURCES

In this section, you'll find useful materials to help you promote and "grow" your Tree Amigos program. Resources include bibliographies, video lists, reference lists, and other items of interest.

TREE AMIGOS BOOK LIST

For more information about trees, forests and other aspects of our environment, you might want to browse the books noted below. Also, the Center maintains a library of books, articles, and other materials dealing with our shared resources. Those books which are part of the Center collection are noted with an asterisk (*).

Jungles. Edward Ayensu, ed. London: Jonathon Cape, 1980. General book on the biology of tropical forests.

* **State of the World 1991: A Worldwatch Institute Report on Progress Toward a Sustainable Society**. Lester R. Brown. New York: W.W. Norton and Co., 1991. Drawing from numerous sources and reports, the book provides a thorough assessment of earth's vital signs. Issued annually since 1983.

* **In the Rainforest: A Report from a Strange, Beautiful, Imperiled World**. Catherine Caufield. New York: Alfred A. Knopf, 1985. An exploration of the wonders and threats to the world's tropical forests and its inhabitants.

* **Indigenous Peoples and Tropical Forest: Models of Land Use and Management from Latin America**. Jason W. Clay. Cambridge, MA: Cultural Survival, Inc., 1988. Summarizes the research undertaken to date and activities used by indigenous peoples to sustain their populations and the environment. Includes attention to gathering forest products, hunting, aquaculture, shifting agriculture, permanent agriculture, and upgrading of the natural resource base.

* **Tropical Nature: Life and Death in the Rain Forest of Central and South America**. Adrian Forsyth and Kenneth Miyata. New York: Charles Scribner's Sons, 1984. An entertaining primer on the ecology of tropical forests with special emphasis on plant and insect life of the New World Tropics.

* **Saving the Tropical Forests**. Judith Gradwohl and Russell Greenberg. Washington, D.C.: Island Press, 1988. Released in conjunction with a major Smithsonian Institution traveling exhibition, this book examines the effects of worldwide deforestation and describes diverse factors contributing to the problem. Also explores solutions on a local level, drawing upon case studies throughout the world.

* **Costa Rican Natural History**. Daniel H. Janzen et.al. Chicago & London: University of Chicago Press, 1983. Very extensive and detailed accounts of plants and animal species in Costa Rica by one of the world's most renowned tropical scientists.

* **Amazon**. Brian Kelly & Mark London. New York: Holt, Rinehart & Winston, 1983. Two journalists offer their first-hand account of the Amazon -- raising questions about unchecked development.

* Sharing Nature with Children. Joseph Cornell. Nevada City, CA: Dawn Publications, 1979. This gem of a book shares guidelines and activities to help the child within us all learn more about the world around us.

* Listening to Nature. Joseph Cornell. Nevada City, CA: Dawn Publications, 1987. Inspiring quotations and stunning photographs guide readers into a deeper awareness of nature.

* A Neotropical Companion: An Introduction to the Animals, Plants, and Ecosystems of the New World Tropics. John C. Kricher. Princeton, N.J.: Princeton University Press, 1979. A primer for the student and for the scientific amateur, this well-illustrated volume presents a general and up-to-date view of some of the world's most complex natural environments.

* The Enchanted Canopy: Secrets from the Rainforest Roof. Andrew W. Mitchell. Glasgow: William Collins Sons & Co., Ltd, 1986. Researcher Mitchell and his colleagues beautifully detail their work in the forest canopy, aided by the use of aerial walkways, hot-air balloons and microlight aircraft.

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* The Primary Source: Tropical Forests and Our Future. Norman Myers. W.W. Norton & Company, New York and London, 1984. An optimistic book about how we can make full use of the tropical forests' products without destroying the forests.

The Tropical Rainforest. Paul Richards. Cambridge, England: Cambridge University Press, 1981.

Notes on a Botanist on the Amazon and Andes. Richard Spruce. New York: MacMillan, 1908. This scientist's reflections and observations give you an historical perspective on what we're losing.

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Tropical Nature. A.R. Wallace. London: Macmillan, 1878. One of the classics in scientific observation by this 19th-century scientist.

* The Global 2000 Report to the President of the U.S. (Volume I: The Summary Report). New York: Pergamon Press, 1983. A sobering compilation of world environmental problems to be faced in the next 20 years. Includes projections of worldwide natural resources availability.

* Our Common Future. World Commission on Environment and Development ("The Brundtland Report"). New York: Oxford University Press, 1987. This book details the key messages issued by the United Nations' World Commission on Environment and Development. Chaired by Norway's Prime Minister Gro Harlem Brundtland, the Commission predicts

fundamental changes to our planet which will require unprecedented international cooperation and new ways for people to relate to their environment.

ESPECIALLY FOR CHILDREN

* Journey Through a Tropical Jungle. Adrian Forsyth. New York: Simon & Schuster, 1988. Features incredible photographs of tropical plants and animals that will delight any child. Forsyth's storytelling ability matches his credentials as a tropical scientist and conveys his love for the Monteverde Cloud Forest in Costa Rica.

The Lorax: Theodor Seuss Geisel (Dr. Seuss). New York: Random House, 1971. A thought-provoking look at deforestation and pollution told only as Dr. Seuss can as he introduces you to the tale of the Truffula trees.

* Nature Hide and Seek Jungles. John N. Wood. New York: Alfred Knopf; 1987. Five distinct jungle ecosystems and their inhabitants are featured as fold-out scenes in this delightful picture book.

* The Very Hungry Caterpillar. Eric Carle. New York: Philomel Books, 1987. Go on a journey and see how one caterpillar became a beautiful butterfly. Also a Spanish version: La Oruga Muy Hambrienta.

* Trees of the Northeast - Coloring Book. Stefan Bernath. New York: Dover Publications, Inc., 1979. The illustrations in this book offer beginners and nature enthusiasts an enjoyable way to identify trees and learn about them.

* Let's Color Michigan. Dirk Gringhuis. Hillsdale, MI: Hillsdale Educational Publishers, Inc., 1971. A read-and-color book that provides information and pictures of Michigan's past, including animals, Indians, fur-traders and much more.

* Zoobooks-Wolves. John Bonnett Wexo. San Diego, CA: Frye and Smith, 1989. The more you learn about wolves, the more wonderful they seem. Learn from this informative and exciting magazine.

* Ponds and Streams. John Stidworthy. Mahwah, New Jersey: Troll Associates, 1990. After reading this book, you too can discover the secret life of ponds & streams.

* 50 Simple Things Kids Can Do To Save The Earth. The Earth Works Group. New York: Andrews and McMeel, 1990. Find out how you can be a water-leak detective, join the "heat busters", grow worms and adopt a stream with this book full of ways to help the environment.

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* How the Forest Grew. William Jaspersohn. New York: Greenwillow Books, 1980. This is a story of a hardwood forest in Massachusetts but it features concepts shared by forests everywhere.

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    Indonesia: This is a pictorial book combined with many interesting facts about the land of Indonesia.

    Costa Rica: This pictorial book displays all aspects of Costa Rica in a very articulate and informative way.

* Once There Was a Tree. Natalia Romanova. New York: Dial Books, 1985. Learn about the life of one particular tree and discover who really owns it.

* The Man Who Planted Trees. Jean Giono. Chelsea, Vermont: Chelsea Green Publishing Co., 1985. Learn of the story of a man's generosity to nature and, through nature, to other humans.

* All About Ponds. Jane Rockwell. Mahwah, New Jersey: Troll Associates, 1984. All the questions you've wondered about ponds can now be put to rest with this innovative question-and-answer book.

* Color the Rainforest. Dwight Holing. Los Angeles, CA: The Living Planet Press, 1990. While children color, they learn about the rainforest and the remarkable plants, animals, and people that live there.

* Forests. Bettina Dudley. Philadelphia, Pennsylvania: Running Press, 1989. Discover the wonders of life in the woodlands with this fact-filled coloring book.

* My First Nature Book. Angela Wilkes. New York: Dorling Kindersley Limited, 1990. This book is full of fascinating nature projects for young children to do in and around home.

* The Rainforest Book. Scott Lewis. Los Angeles, CA: Living Planet Press, 1990. This book allows you to journey to the tropical rainforests and learn about their amazing diversity, the threats to their survival, and the ways we can preserve them for future generations.

* Winter Tree Finder. May Theilgaard Watts and Tom Watts. Berkley, CA: Nature Study Guild, 1970. This is an extremely helpful book in deciphering deciduous trees in winter.

* Tree Finder. May Theilgaard Watts. Berkley, CA: Nature Study Guild, 1986. With this helpful manual you can discover the many trees of the United States by their leaves.

* Wonders of the Jungle. Washington, DC: National Wildlife Federation, 1986. Everything you ever wanted to know about jungles is in this informative and delightful book.

* Butterfly and Moth. Paul Walley. New York: Alfred A. Knopf, 1988. Discover the close-up world of butterflies and moths - their structure, behavior, habitats, and secret life.

* Tree. David Burnie. New York: Dorling Kindersley Limited, 1988. Discover the life of a tree in close-up from tiny seed to forest giant to woody skeleton.

* The Young Naturalist. Andrew Mitchell. London, England: EDC Publishing, 1989. This exciting book is an introduction to nature study for complete beginners. It also shows how to set about collecting, observing and experimenting in the natural world.

* RANGER RICK'S NATURE SCOPE SERIES: Washington, DC: National Wildlife Federation. A great series of publications, with classroom-ready "copy cat" pages and group activities and projects.

- Wild About Weather - 1989. While exploring the world of weather it is possible to learn about the water cycle, seasons, air pressure, color, air pollution and animal and plant adaptations.
- Discovery Deserts - 1989. This book shows how animals and plants adapt to their environments as well as learning about Native American culture by studying the desert today.
- Birds, Birds, Birds - 1989. A lot of people have looked to birds for inspiration, as well as food and clothing - now you can learn about bird basis and the seriousness of habitat loss to the dangers of pollution on birds.
- Digging Into Dinosaurs - 1989. Learn about the many aspects of prehistoric life, including dinosaurs, in a fun and stimulating way.
- Incredible Insects - 1989. This exciting book provokes childrens natural interest in learning more about insects.
- Geology: The Active Earth - 1988. With this, kids can discover more about the make-up of their planet and also find out that only the surface has been scratched of what there is to know about the earth.
- Endangered Species: Wild and Rare - 1989. This book explains which species are in trouble and how all species interact so that kids can discover now how crucial habitat protection is.
- Let's Hear It For Herps! - 1987. Enter the bizarre and fascinating world of reptiles and amphibians with this creative book.
- Trees Are Terrific! - 1988. Learn about how trees provide homes and food for wildlife and even act as "water filters" in many natural communities, with this exciting book.

- Amazing Mammals Part I - 1989. This provides a general introduction to mammals, such as the characteristics that make a mammal, how they survive, and how they influence other mammals.

- Amazing Mammal Part II - 1989. Continue your study of many diverse mammals with this sequel of Amazing Mammals.

- Astronomy Adventures - 1989. In this informative book you will learn about black holes and gravity to lunar walks and space probes.

- Diving Into Oceans - 1989. Explore the physical, biological, historical, and environmental aspects of the sea with this informative book on the marine world.

- Wild and Crafty - 1988. Learn how you can make crawling spiders, climbing monkeys and roaring lions with this fun and exciting book that will provide hours of enjoyment.

- Rainforests: Tropical Treasures - 1989. Find out how you can help protect these tropical treasures as you find out about the problems associated with deforestation.

* NATIONAL GEOGRAPHIC ACTION BOOK SERIES. Washington, DC: National Geographic Society, 1989.

- Hide and Seek. This pop-up book provides an exciting way to look at all aspects of nature while you learn about the environment.

- Animal Homes. Learn about the different types of homes that animals live in and how they adapt to their surroundings, with this pop-up book.

- Amazing Monkeys. Everything you ever wanted to know about monkeys and their lifestyles is in this innovative pop-up book.

- Explore a Tropical Forest. Journey to a tropical rain forest and explore the natural surroundings associated with this environment with this pop-up book.

- The Kapok Tree. Lynne Cherry. Harcourt Brace Javanovich, 1990. A magical and beautifully illustrated tale about the wonders of the Amazon rain forest and the marvelous creatures that inhabit it, with a conservation message that speaks to both children and adults.

* The Sense of Wonder. Rachel Carson. Harper & Row Publications, 1956. Narrative and photographs can help awaken the sense of wonder in us all through this classic.

* Beginnings. Washington, DC: National Wildlife Federation, 1989. Learn about various subjects in this informative book including useful knowledge of geese, mushrooms, frogs and even some of the seasons.

- One Day in the Woods. Jean Craighead George. New York: Thomas Y. Crowell, 1988. Join Rebecca, a young explorer, in search of the ovenbird, and discover the magical essence of the woodlands

- Rainforest Secrets. Arthur Dorros. New York: Scholastic Inc., 1990. In this close-up look at an incredible variety of animals and plants, readers explore the balance of life in the Amazon.

- Jungles. Clive Catch Pole. New York: Dial, 1989. This simple fascinating text and realistic artwork answers many questions while satisfying every child's curiosity about the jungle.

- Ecology Projects for Young Scientists. Martin J. Gutnik. New York: Franklin Watts, Inc., 1984. This exciting book contains science theories and many project ideas related to ecology and the environment for children to do on their own just for fun or even to enter into a school science fair.

- Earth Book For Kids: Activities to Help Heal the Environment. Linda Schwartz. Santa Barbara, CA: The Learning Works, Inc., 1990. Fascinating facts and creative ideas for activities to help kids become better acquainted with their environment and learn to care for the earth.

The Environment: Endangered Species

The Recycler's Handbook, 1990, The Earth Works Group (nonfiction).

Burningham, John. Hey! Get Off Our Train, 1989, Crown. (fiction)

Wright, Alexandra. Will We Miss Them? Endangered Species, Alexandra Wright, Illus. 1992, Charlesbridge (nonfiction).

Wegen, Ron. Where Can the Animals Go?, 1978, Greenwillow. (fiction)

O'Neill, Mary. Nature in Danger, John Bindon, Illus. 1991, Troll (nonfiction).

Goodman, Billy. A Kid's G[illegible]e to How to Save the Animals, Paul Meisel, Illus. 1991, Avon (nonfiction).

Saving Our Animal Friends, 1990, Zoobooks.

Irvine, Georgeanne. Protecting Endangered Species at the San Diego Zoo, 1990, Simon and Schuster. (nonfiction)

Littlejohn, Claire. The Modern Ark: The Endangered Wildlife of Our Planet, 1991, Dial (nonfiction).

Whitfield, Philip. Can the Whales Be Saved? 1989, Viking Kestrel. (nonfiction)

Cowcher, Helen. Antarctica, 1990, Farrar, Straus and Giroux. (fiction)

Glimmerveen, Ulco. A Tale of Antarctica, 1989, Scholastic. (fiction)

Turner, Ann. Heron Street, Lisa Desimini, Illus. 1989, Scholastic. (fiction)

Stone, Lynn M. Endangered Animals, 1984, Children's Press (nonfiction).

Cartwright, Marg. Protecting Endangered Species, Steven Kirk, Illus. 1990, Usborne (nonfiction).

Yeh, Phoebe and Nancy E. Krulik. Save the Animals, Megan Halsey, Illus. 1991, Scholastic (coloring book).

(Ed. note; The following bibliography was compiled by Barbara A. Reed, an educational consultant. She can be reached at 847 Baker Street, Lansing, MI 49810, USA; Telephone: (517) 487-5163.

The Environment: Saving Our World

Jeffers, Susan with Chief Seattle. Brother Eagle, Sister Sky, 1991, Dial (fiction/nonfiction).
Peet, Bill. The Wump World, 1970, Houghton Mifflin. (fiction)
Seuss, Dr. The Lorax, 1971, Random House. (fiction)
Van Allsburg, Chris. Just a Dream, 1990, Houghton Mifflin. (fiction)
Wilcox, Charlotte. Trash, Jerry Bushay, Photographer, 1988, Carolrhoda Books. (nonfiction)
Too Much Trash, Weekly Reader, Vol. 60, Issue 18 (February 8, 1991).
Hadingham, Evan and Janet. Garbage! Where It Comes From Where It Goes, 1990, Simon and Schuster (nonfiction).
Stille, Darlene R. Air Pollution, 1990, Children's Press (nonfiction).
_______. Water Pollution, 1990, Children's Press (nonfiction).
O'Neill, Mary. Water Squeeze, John Bindon, Illus. 1990, Troll (nonfiction).
_______. Power Failure, John Bindon, Illus. 1991, Troll (nonfiction).
50 Simple Things Kids Can Do to Save the Earth, The Earth Works Group, Michele Montez, Illus. 1990, Scholastic. (nonfiction)
50 Simple Things You Can Do to Save the Earth. The Earth Works Group, Michele Montez, Illus. 1990, Scholastic (nonfiction).
Middleton, Nick. Atlas of Environmental Issues, 1989, Factson File. (nonfiction)
Elkington, John, et al. Going Green: A Kid's Handbook to Saving the Planet, Tony Ross, Illus. 1990, Puffin. (nonfiction)
Goodman, Billy. A Kid's Guide to How to Save the Planet, Paul Meisel, Illus. 1990, Avon. (nonfiction)
Dehr, Roma and Ronald M. Bazar. Good Planets Are Hard to Find!, Nola Johnston, Illus. 1989, Earth Beat Press (nonfiction).
MacEachern, Diane. Save Our Planet, Lonni Sue Johnson, Illus. 1990, Dell (nonfiction).
Rosser, J.K. Teenage Mutant Ninja Turtles ABCs for a Better Planet. The Gee Studio, Illus. 1991, Random (nonfiction).
Werenko, Lisa K. It Zwibble and the Greatest Cleanup Ever! Tom Ross, Illus., 1991, Scholastic (nonfiction).

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The Environment: Rain Forest

Cherry, Lynne. The Great Kapok Tree, 1990, Harcourt Brace Jovanovich. (fiction, informational)

Cowcher, Helen. Rain Forest, 1988, Farrar, Straus and Giroux. (fiction, informational)

Willow, Diane. At Home in the Rain Forest, Laura Jacques, Illus. 1991, Charlesbridge (nonfiction).

Baker, Jeannie. Where the Forest Meets the Sea, 1987, Scholastic (fiction, informational).

George, Jean Craighead. One Day in the Tropical Rain Forest, Gary Allen, Illus. 1990, Harper Collins (nonfiction).

Althea. Rain Forest Homes, 1985, Cambridge University Press (nonfiction).

Craig, Janet. Wonders of the Rain Forest, S.D. Schindler, Illus. 1990, Troll (nonfiction).

Parrots, 1991, Zoobooks (nonfiction).

Stone, Lynne M. Eco Zones: Rain Forests, 1989, Rourke Enterprises (nonfiction).

Landau, Elaine. Tropical Rain Forests Around the World, 1990, Franklin Watts (nonfiction).

The Rain Forest Eco Guide Unfolds, Van Dam Publishers (nonfiction).

Lewis, Scott. The Rainforest Book, 1990, Living Planet Press (nonfiction).

Lambert, David. Forests, 1990, Troll (nonfiction).

Cartwright, Mary. Protecting Trees and Forests, Kirk, Chesterton and Bull, Illus. 1991, Usborne.

Spencer, Guy J. An Ancient Forest, Frank Staub, Photographer, 1988, Troll (nonfiction).

Sterling, Tom. The Amazon, 1973, Time Life (nonfiction).

Newman, Arnold. Tropical Rainforest, 1990, Facts on File (nonfiction).

Mitchell, Andrew. Vanishing Paradise: The Tropical Rainforest, Stephen Dalton and George Bernard, Photographers, 1990, Overlook Press (nonfiction).

Tasker, Georgia. "Rape of the Rain Forests: A Cause for Global Concern," Habitat, Vol. 3, Article No. 40, 1986 (nonfiction).

Hosmer, Ellen. "Paradise Lost; The Ravaged Rainforest," Habitat, Vol. 3, Article No. 51, 1987 (nonfiction).

Adopt an Acre of Rain Forest as a Birthday Gift to the Earth: Teacher's Guide, for information: The Earth's Birthday Project, 170 Joralemon Street, Brooklyn, N.Y. 11201.

Lynne Cherry's Environmental Newsletter, September, 1991. (Write to Lynne Cherry, SERC, P.O. Box 28, Edgewater, MD 21037-0028).

Rain Forest (video). National Geographic Society. $26.95. To order, call 800-368-2728.

Rain Forest Rap, World Wildlife Fund, 1250 24th St. NW, Washington, DC 20037.

Rain Forest Calendar 1991, World Wildlife Fund (see above).

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References for Learning Activities

Hillcrest Environmental Action Council
1415 Lyon NE
Grand Rapids, MI 49503

"Looking Good in Ohio Schools"
Ohio Department of Natural Resources
Office of Litter Control
1855 Fountain Square Ct
Columbus, OH 43224

"The Fourth "R"
Wisconsin Department of Natural Resources
IE/4 Box 7921
Madison, WI 53707

"Recycling Fact Sheet"
Earth Day 1990
P.O. Box AA
Stanford, CA 94309

Keep America Beautiful Inc.
Mill River Plaza
9 West Broad Street
Stanford, CT 06902

"E E News," Vol. 7, No. 2
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

"Trees Are Terrific" Ranger Rick's Nature Scope
National Wildlife Federation
1400 Sixteenth St NW
Washington, DC 20077

"A Teacher's Guide"
The Urban Environment
J.G. Ferguson Publishing Co. 1975
11 S Broadway
Red Lodge, MT 59068

"Nature's Recyclers Activity Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

"K-3 Supplement to the Recycling Study Guide"
Wisconsin Department of Natural
Resources Bureau of Information and Education
P.O. Box 7921, Madison, WI 53707

"Recycling Study Guide"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

"Wisconsin Explorer"
Wisconsin Department of Natural Resources
Bureau of Information and Education
P.O. Box 7921
Madison, WI 53707

"Project Wild Elementary Activity Guide"
Western Regional Environmental Education Council
P.O. Box 18060
Boulder, CO 80308

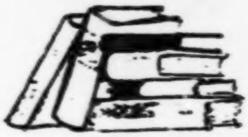
"Here Today, Here Tomorrow-Revisited"
NJDEP, Division of Solid Waste
Management Education Program
CN 414, 401 E State St
Trenton, NJ 08625

"Global Releaf"
American Forestry Association
P.O. Box 2000
Washington DC 20013

"Reduce, Reuse, & Recycle Activities For All Grades"
Waste Education Clearinghouse
Office of Waste Managment
1350 Energy Lane
St. Paul, MN 55108

"Oscar's Options"
83 Park St
Providence, RI 02903

"Paddle to the Sea"
Ohio Sea Grant Education
Ohio State University
059 Ramseyer Hall
29 West Woodruff
Columbus, OH 43201



BOOKS FOR YOUNG RECYCLERS

NOTE: This is a listing of books which have been printed concerning solid waste. Some books are out of print and may be available through libraries or specialty bookstores.

About Garbage and Stuff. Ann Zane Shanks, with photographs by the author. Viking Press, New York, 1973.
An introduction to the concepts and process of recycling waste materials. Uses a real family in a direct photographic narrative with accompanying text. Approximate grade level 3.*

A World Fit for Chipmunks and Other Living Things. Available from MPCA. (See Minnesota Resources.)
Coloring book on recycling, litter, intended for Grades K-3.

Clean Streets, Clean Water, Clean Air. Chapin, Cynthia; Albert Whitman and Co., Chicago, 1970; 31 pages, $7.75; 560 West Lake Street, Chicago, IL 60606.
About street cleaning, garbage disposal, sewage treatment, water filtration, etc. Early childhood — Grade 3.

Garbage As You Like It: A Plan to Stop Pollution By Using Our Nation's Wastes. Jerome Goldstein, Rodale Books, Inc., 1969.
Explains that each one of us, as individual citizens, are the ones who will decide how the waste disposal problem will be solved. Introduces the concept of composting as a solution to the waste problem. Junior-Senior High School.

Garbage: The History and Future of Garbage in America. Katie Kelley, Saturday Review Press, 1973.
A humorous, but fully documented history of garbage which includes a survey of the entire field of garbage collection and disposal today. Junior and Senior High.

Garbage: The History and Future of Garbage in America. Saturday Review, 1973.
Garbage accumulation and unnecessary packaging is promoted by American technology to the extent that U.S. Government is the nation's largest litterbug. Junior and Senior High.

Going to Waste: Where Will All the Garbage Go? James Marshall, Coward, McCann and Geoghegan, New York, 1972.
Discusses the solid waste problem in the United States and gives concrete contributions the individual can make to find a safe, practical and profitable means of waste disposal. Approximate grade level 9.*

How Do They Get Rid of It? Suzanne Hilton, Westminster Press, Philadelphia, 1970.
How we really do get rid of wastes is sometimes shocking, sometimes frightening, and many times, hopeful. This book explains the problems and how trash can become a treasure. Approximate grade level 7.*

It's Your Environment — Things to Think About, Things to Do. Environmental Action Council, Charles Scribner's Sons, New York, 1976.
Text, illustrations and suggested projects in recycling paper and metal, solid waste and packaging. Approximate grade level 3-6.*

Let's Be Nature's Friend! Written and illustrated by Jack Stokes, H.Z. Walck, New York, 1977.
Offers suggestions, in verse, for improving our environment through such activities as recycling glass bottles, putting tea leaves on the garden, and writing congressmen to encourage their passing laws against pollution. Approximate grade level 3.*

Let's Go To A Recycling Center. Michael Chester, Illustrated by Paul Frame. G.P. Putnam's Sons, New York, 1977.
Kathy becomes interested in cleaning up. She visits a nearby recycling center and learns how to sort each type of material into its correct place. Later, she goes on a bus tour to manufacturing plants for glass, metal, and paper to see these items processed. Includes glossary and list of things to do. Grades 3-4.

Minnesota Pollution Control Agency
Division of Solid and Hazardous Waste
Second Edition

Let's Go To A Sanitation Department. Joanna Cochrane Harris, G.P. Putnam's Sons, New York, 1972.
Describes useful ways to use garbage with high technology — burning to make electricity, burned and used to make gravel and cement, etc. Describes the sanitation departments role in ecology. At the end of the story is a list of projects which children can do. Approximate Grade 6.*

Litter — The Ugly Enemy: An Ecology Story. Dorothy E. Shuttlesworth. Doubleday and Company, Inc., Garden City, New York, 1973.
Describes how litter pollution is studied, and how it is conquered by scientists, technicians, and private citizens. Approximate grades 7-8.*

Man and His Environment: Waste. Wesley, Marx, Harper and Row Publishers, New York, 1971; 178 pages, $6.00, $3.25 paperback, 49 East 33rd Street, New York, NY 10016.
Concerned with proper waste disposal — the problems and possible solutions. Grades 10-12.

Nature's Assistant. Victoria Cox and Stan Applebaum, Golden Press, New York, 1974.
Compares man's waste disposal process. Man should become nature's assistant by recycling wastes. Approximate Grades 6-7.*

Only Silly People Waste. By Norah Smaridge, illustrated by Mary Carrithers, Abingdon Press, Nashville and New York, 1976.
Fourteen humorous poems make a case for conservation of electricity, toothpaste, paper, water, band-aids, and other frequently wasted items. Approximate grade level 6.*

Our Dirty Land. Written and illustrated by Sarah M. Elliot, Julian Messner, New York, 1976.
Discusses many aspects of our present, polluted environment, including refuse disposal methods, the Wilderness Act, strip-mining, pesticides, land laws and activities to make each one of us a land saver. Approximate grade level 4-5.*

Recycling: How to Reuse Wastes in Home, Industry, and Society. Jerome Goldstein, Schocken Books, 1979.
By using experiences of different people and organizations across the country, waste reduction and recycling are described. It also explains the personal and social problems associated with high waste generation. Junior and Senior High.

Recycling Resources. Lawrence Pringle, Macmillan Publishing Co., Inc., New York, 1974.
Shows how the solid waste problem began and what can be done about it. It explains current methods of recycling and describes the research that may lead to new methods. Grade 7.*

Recycling: Reusing Our World's Solid Wastes. James and Lynn Hahn, Franklin Watts, New York, 1973; 66 pp. illustration.
Explains recycling, man's need for it, and present and suggested methods of performing the task of reusing waste materials. Approximate grade level 7.*

Recyclopedia: Games, Science Equipment and Crafts from Recycled Materials. Simon, Robin, Houghton Mifflin, Boston, 1976.
How to create exciting new things from inexpensive readily available objects we tend to ignore. Activities for Grades K-5.

Save It: Keep It! Use It Again! A Book About Conservation and Recycling. R.J. Lefkowitz, illustrated by John E. Johnson. Parent's Magazine Press, New York, 1977.
Discusses the ways that scarce natural resources can be conserved through recycling. Approximate grade level 5.*

Sparrows Don't Drop Candy Wrappers. Margaret Gabel, illustrated by Susan Perl. Dodd, Mead, New York, 1971.
Simple do's and don'ts telling how each one of us can help in small, vital ways to make this world a better place to live. Approximate grade level 4.* May recommend activities which are extreme to the goals of an environmental education program.

The Compost Heap. Harlow Rockwell, Doubleday and Co., Inc., Garden City, New York, 1974.
Explains in simple terms how a compost heap is made and how it turns into soil. Colorfully illustrated. Grades 2-4.*

Available from PSU Division of Continuing Education, P.O. Box 1383, Portland, OR 97207, or telephone 503/229-4890.

The Soiled Frontier
27 min., 1973, Rental $15.25 (1-2 days)

An interesting, well-made Oregon film showing air, water, and solid waste pollution problems. Contrasts Oregon beauty with Oregon eyesores. Effective selection of detail for camera work, and recognizable scenes give impact. Deals with auto exhaust, oil, junk cars, litter and the bottle bill, and estuary landfill. Asks the viewer to make a personal commitment to protecting the environment. Shows the importance of small acts and creates a positive attitude by showing successful clean-ups and improvements. (Review from Garbage Reincarnation.)

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Available from the University of Iowa, Audio Visual Center, C-4 Seashore Hall, Iowa City, IA 52242, or telephone 319/353-5885.

Recycling Waste
#U30214, 16mm, color, sound, 12 min.
Rental $10.30 (3 days)

Demonstrates Recycling of paper, glass and metal, thus turning waste and trash into a resource. Also raises the question of who bears the cost for cleaning up the environment. Final sequence suggests technology may be used to change waste matter from something that works against us, to something that works for us.

Garbage Explosion: Saving the Environment
#US30253, 16mm, color, sound, 16 min.
Rental $12.00 (3 days)

Depicts the seriousness of the garbage disposal problem and some legal and illegal methods used to cope with it.

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Available from Eastern Film Depository, 11 Quire Street, Cranford, NJ 07016, or telephone 800/631-7345.

Litterbug
Rental $20.00

A Donald Duck film that illustrates several kinds of litter bugs — the beach bug, the sneak bug, the car-riding bug — and illustrates the seriousness of the litter problem by reducing it to the laughable. Use this to introduce the whole notion of litter, and have students orally describe other varieties of litter bugs they have observed. A possible follow-up is to sketch cartoons showing the varieties of litter bugs.

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Available from Texture Films, Inc., P.O. Box 1137, Skokie, IL 60076, or telephone 312/256-4436.

More

An award-winning non-verbal animated film showing how the earth is straining to meet man's ever-growing consumption. A good introduction for other films which present possible solutions. 1973. 3 min., Grade 3 and up. Purchase $160.00, or rental $35.00 (one day showing).

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Available from MPCA, 1935 West County Road B2, Roseville, MN 55113, or telephone 612/296-7373 (Public Information Office).

Junk Dump
10 min.

This film uniquely presents the problem of solid waste disposal. It portrays one day in the life of a couple who pursue their "normal" activities in a garbage dump setting. Primary grades.

Urban Ecology: Garbage Disposal
Color, 8 min., 16mm film
#03514; Rental $7.45

Discusses ways in which cities dispose of trash and garbage by burning it, by covering it with dirt, or by dumping the ocean, and points out the need to find new methods of disposal, such as recycling. Asks the question, "What we do to make less trash?" A 1971 production.

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Available from Pathway Productions, 0350 SW Dakota Street, Portland, OR 97201, or telephone 503/244-7292.

Recycling: Waste Into Wealth
3/4", 1/2" (VHS and BETA) Video tape
30 min., 16mm film
Purchase price — $450.00

Film presents information on recycling, its benefits to the community, labor, and the environment. The film is extremely well done and includes discussions on curbside recycling and composting. A 1983 production.

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Available free from the Aluminum Association, Inc., 818 Connecticut Avenue, N.W., Washington, D.C. 20006, or telephone 202/862-5100.

Recycling: A Way of Life

A 16mm, color, 20 min., sound motion picture which presents various recycling activities in an urban environment — composting, reusing, and materials recycling. The film follows the aluminum recycling process from can collection to loading the aluminum or shipping pallets.

Recycling: Lifestyle With a Future

A filmstrip kit which focuses on the connection between lifestyle and recycling. To practice recycling effectively, students must change habits of consumption and rethink attitude.

PAMPHLETS, NEWSLETTERS . . . ETC.

1. "Eco-News," a cheerful, informative, cartoon-illustrated newsletter about the environment for today's urban and suburban children, Grades 4-6. Each 8-page issue explores a different environmental theme that youngsters can relate to, and is packed with learning activities for young people to do on their own, or together with classmates and teachers. Available from Environmental Action Coalition, 156 Fifth Avenue, New York City, NY 10010. Write for information and price sheet.
2. "Michael Recycle," a colorful comic book where Michael Recycle teaches children not to throw away things that can be used again — especially aluminum products. Distributed by Reynolds Aluminum Recycling Co., Richmond, VA 23261.
3. "The Garbage Game," a jigsaw puzzle ecology game. Each 128-piece puzzle contains 7 colorful cartoons. Each cartoon depicts an everyday situation in which people at home waste or throw away materials — and suggests ways in waste material could be recycled. For 2-6 players, Grade 5 and up. Produced by Spinnaker, Enfield, Connecticut 06082. Available on loan basis from the ECOL Library.
4. "Environmental Action: Recycling Resources," The Creative Teacher, 1971. Sponsored by Continental Can Co. A game that can be played in the classroom by up to 20 students at a time. Includes filmstrips and facilitates discussion of recycling issues. Junior High and up. Available on loan basis from the ECOL Library.

Recycling
20 min.

Shows some emerging techniques on reuse, recovery, and recycling of resources — how materials now ending up as municipal solid waste can be used to extend the supply of natural resources.

How About It?
7 min.

Children themselves demonstrate how they can join the fight against litter — reminding others to use litter baskets, picking up and disposing of trash, and helping to keep their community clean.

Meecology
30 min.

An excellent environmental film for children, produced by McDonalds. The film stresses what children can do to help protect our environment.

Use It-Use It Up
25 min.

MPCA slide and cassette tape narrative describes how the goals of conserving resources and reducing waste at the source make economic and environmental sense. Provides suggestions to accomplish these goals. 1977. Grade 5 and up.

Let's Help Recycle
11 min.

ACI Productions. Shows school children going before the City Council to report on recycling. Shows students preparing materials for recycling. Encourages source reduction. Would probably hold interest of younger students. 1973. Grades 3-7.

Recycling Resources

Association of Secondary Materials Industries. Discusses recycling and how it works, what major recycling problems are, and how the public, industry, and government can help the recycling effort. 1971 filmstrip.

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Available from FilmFair Communications, 10900 Ventura Boulevard, P.O. Box 1728, Studio City, CA 91604, or telephone 213/985-0244. Also available from California Extension Media Center, 2223 Fulton Street, Berkeley, CA 94720, or telephone 415/642-0460.

Recycling in Action
14 min., 16mm film
Code number 604.6
Purchase — $245.00; Rental — $25 (FilmFair), $26 (University)

The film first establishes the need for recycling solid waste products in a society of "endless consumption" and then makes a general introduction to community reclamation centers.

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Available from Third Eye Films, 12 Arrow Street, Cambridge, MA 02138, or call 617/354-1500.

Energy Where You Least Expect It
28 min., 16mm film
Purchase — $450.00; Rental — $45.00

Seven successful waste-to-energy products (large and small scale) are documented. A number of different technologies are also illustrated, including recycling. The film is humorous and upbeat. Narrated by Max Gail of ABC's "Barney Miller" T.V. show.

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Available from Journal Films, Inc., 930 Pither Avenue, Evanston, IL 60202, or call 312/328-6700, toll-free 800/323-5448.

Recycling Wa[illegible]
12 min., 16mm film
Rental (3 days) — $25.00

> Shows how raw materials can be conserved and pollution curbed by turning waste into useful products. Also explores who will bear cost for cleaning up the environment. Designed for Intermediate, Junior to Senior high school.

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Available from Bullfrog Films Inc., Oley, PA 19547, or telephone 215/779-8226.

Organic Gardening: Composting
11 min., 16mm film
Rental — $20.00; Purchase — $200.00

> Film shows how to make a compost heap using live action and animation. Includes what ingredients to use; in what proportion; and how to layer the heap to ensure speedy and uniform decomposition. Interesting for upper elementary, junior and senior high students and adults.

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Available from Bureau of Audio-Visual Instruction, University of Wisconsin-Extension, P.O. Box 2093, Madison, WI 53715.

Man Builds, Man Destroys: Through the Mill Once More
Film #0030, 1974
Color, 30 min., 16mm film
Rental $12.50

> Presents some of the realities of action that man has taken in the area of recycling to prescribe the limited resources of this planet. Covers such activities in a number of countries including Japan, Belgium and the United States. Shows one U.S. town that has adopted almost a complete recycling program. May be purchased from Great Plains National Instruction Television Library, P.O. Box 80669, Lincoln, NE 68501. The purchase price is $450.00.

Stuff We Throw Away
Film #7923, 1971
Color, 22 min., 16mm film
Rental $11.00

> Discusses solid waste disposal. Illustrates several management techniques operating nationwide (as of 1967), which are supported partially by the Environmental Protection Agency.

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Available from University of Illinois Film Center, 1325 South Oak Street, Champaign, IL 61820, or telephone 1-800-367-3456.

The Garbage Explosion (Saving the Environment)
Color, 16 min., 16mm film
#54623; Rental — $10.00

> Uses live-action photography to investigate the nature, volume, and composition of solid wastes produced by our modern society. Discusses advantages and disadvantages of current disposal methods. High temperature incineration, research into development of water-soluble glass, and efforts to convert solid wastes into reusable metal products are shown as examples of some new ways of cleaning up our environment. A 1970 production.

Up to Our Necks: The Garbage Problem
Color, 25 min., 16mm film
#32134; Rental $13.70

> Documents the colossal problem of waste disposal in modern society and explores some of the alternatives now available in the search for solutions. A 1969 production.

There Lived A Wicked Dragon. U.S. EPA, 1973. Available from MPCA. (See Minnesota Resources.)
An environmental coloring book for adults and children.

The Waste Watchers: A Citizen's Handbook for Conserving Energy and Resources. Aurthur H. Purcell, Doubleday/Anchor Press, 1980.
Describes practical waste-reducing strategies each of us can practice to make our lives safer, cleaner, cheap, and more pleasant. Junior-Senior High School.

Too Much Garbage. Patricia Lauber, Garrard Publishing Company, Chicago, Illinois, 1974.
Explains the solid waste problem, and then explores ways in which we can stop wasting waste and harming our environment, especially making less garbage. Approximately Grades 2-3. *

Waste is Wealth. C. Leroy Hacker, Dorrance & Company, Philadelphia, 1970.
Suggests ways by which the garbage problem can be alleviated through reclaiming waste and converting it into useful and necessary products. Junior-Senior High School.

What Happens to Garbage? Rona Beame, Julian Messner, New York, New York, 1975.
Discusses the means used by New York City to dispose of its refuse and what new disposal methods are currently being considered. Approximate Grade 5. *

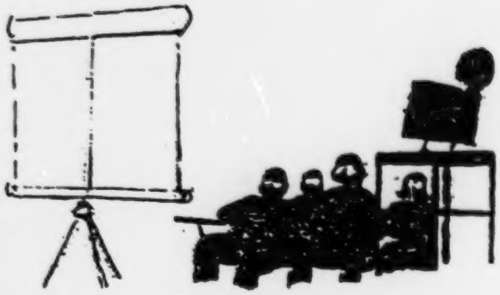
Where Does the Garbage Go? Paul Showers, illustrated by Loretta Lustig. Corwell, New York, 1974.
Explains what happens to our garbage once it has been dumped — where it goes and how it can be used. Approximate grade level 4. *

Who Cares: I Do. Leaf Munro, J.B. Lippincott Co., Philadelphia, 1971.
A well-illustrated booklet on the ugliness of litter, explaining why we should care about our environment. Many photographs. Grades 4-6.

Who Keeps America Clean? Barbara Steinbert, Random House, New York, 1976 (one of a series of career education books).
Career opportunities in the field of environmental protection, featuring first person accounts by a wildlife manager, civil engineer, recycling plant manager, noise-pollution inspector, sewage plant operator, and others. Approximate grade level 5. *

AUDIO VISUALS

Available from the General Services Administration, National Archives and Records Service, National Audio-Visual Center, Washington, D.C. 20409, or telephone 301/763-1896.



The Phoenix
22 min., 16mm film
Title No. 009234/RE Rental $12.50; Sale $127.50

> Explores the materials use cycle and its role in solid waste. Traces the collection, transportation, and disposal of waste in Kansas, and analyzes current attempts to recover materials and energy from the solid waste stream. Discusses proper waste management practices, focusing on land disposal of municipal wastes and safe disposal of feed-lot wastes which are abundant in a state with large cattlefeeding operations. Suggests what roles the consumer can play in such programs.

The Realities of Recycling
39 min., 16mm film
Title No. 002177/RE Rental $15.00; Sale $226.25

> Shows a variety of equipment being used to recover and reuse materials from solid wastes. Existing markets for glass, aluminum, and steel containers, paper and old car hulks are described. Along with new technology being investigated and demonstrated under provisions of the Solid Waste Management Act.

Recycling
22 min., 16mm film
Title No. 002180/RE Rental $12.50; Sale $127.50

> Shows a variety of efforts to recover and reuse more of our discards. Explains how this approach adds the dual benefit of conserving our resources while minimizing the expense and difficulty of solid waste disposal. Illustrated new techniques that are being investigated and demonstrated under provisions of the Solid Waste Management Act.

The Stuff We Throw Away
23 min., 16mm film color
Title No. 0022001/RL Rental $12.50; Sale $133.50

> Describes the massive problem of collecting and disposing of America's solid wastes. (Review by MUCC.)

• • • • •

Available from Learning Corporation of America, Sales/Service Dept., 1350 Avenue of the Americas, New York, NY 10019, or telephone 212/397-2655.

Uncle Smiley Goes Recycling
13 min., color, 16mm film, 1972
Rental $25.00; Sale $225.00

> Entertaining, spirited and therefore possibly motivating. Child should understand the concept of recycling before viewing. A group of children come into Uncle Smiley's Shop and persuade him to take them "recycling." They pick up various items in a pushcart and later transport them in a bright red antique car (which turns out to be a polluter). No narrative; the slapstick action is set to music. Top recommendations from previewers. Grades K-6. (Review from Garbage Reincarnation.) Film is available in all video formats.

• • • • •

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A-Way with Waste (teacher guide). 1989. Washington State Department of Ecology, Waste Reduction, Recycling, and Litter Control Program, Eikenberry Building, Mailstop PV-11, Olympia, WA 98504

Bottle Biology Resources Network (A Project of the Center for Resources Education). University of Wisconsin, B-37 Russell Laboratories, 1630 Linden Dr., Madison, WI 53706

"Buried Alive, The Garbage Glut: An Environmental Crisis Reaches Our Doorstep." Newsweek, November 27, 1989.

Earthkeepers — Four keys for helping young people live in harmony with the earth. (1987). Steve Van Matre, and Bruce Johnson. The Institute for Earth Education, Box 288, Warrenville, IL 60555.

Everything Goes Somewhere (study guide). 1989. University of WI Extension, College of Natural Resources, U-W Stevens Point, Stevens Point, WI 54481.

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Nature Scope Series. National Wildlife Federation, 1412 16th St. NW, Washington, DC 20036-2266.

OBIS (Outdoor Biology Instructional Strategies). 1982. Delta Education, Box M, Nashua, NH 03061.

Oscar's Option. Ocean State Clean Up and Recycling. Dept. of Envir. Management. Providence, RI 02908.

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Project Learning Tree. American Forest Council, 1250 Connecticut Ave., N.W., Washington D.C. 20036.

Project Pride. Quality Forward. P.O. Box 22, Asheville, NC 28802.

Recycle Alaska: Activities Handbook. 1982. Dept. of Envir. Conservation, Pouch O, Juneau, AK 99811.

Recycle For Reuse: 4-H leader-member-family guide. 1985. 4-H Programs, University of WI Extension, Madison, WI 53706. Publ. No.362.

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Sunship Earth: An Acclimatization Program for Outdoor Learning. 1979. Steve Van Matre. Acclimatization Experiences Institute, Box 288, Warrenville, IL 60555.

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The Fourth "R" — An Action Booklet for Recycling in the Classroom and School. 1990. Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

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The Nature Specialist — A complete Guide to Program and Activities. Lenore Hendler Miller. American Camping Association, Martinsville, IN.

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1855 Fountain Square Ct
Columbus, OH 43224

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83 Park St
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ADDITIONS TO YOUR NOTEBOOK

TREE AMIGOS

Center for Environmental Study • Centro de Estudio Ambiental

January 21, 1993

Hola **Tree Amigos** teachers and friends,

- The following pages are the second supplement to be added to your **Tree Amigos** Resource Book:

...**Tree Amigos Vocabulary/Vocabulario** - replaces the previous vocabulary activity

...**Aluminum Can Collection** - add to the **Tree Amigos Action Projects** section

...**Foods from the Tropical Forests** - add to the **Tree Amigos Action Projects** section

...**What Kind of Tree Is It?** - add to the **Trees** section

...**Watershed Activity Sheet for Upper/Lower Elementary Students** - add to the "Exploring a Watershed" Activity in the **Land Use** section

...**A Conceptual Framework for Environmental Education** - add to the **Background Learning for Teachers** section

...**The Great Lakes Ecosystem Primer** - add to the **Background Learning for Teachers** section

...**Selected Bibliography on Endangered Species, Saving Our World, and Rain Forest** (compiled by Barbara A. Reed) - add to the **Resources** section

...**Tree Amigos Order Form** - Place in the back pocket of the Resource Book, or better yet, place an order with us!

- We have also included a free educational packet. Entitled TWEETY'S GLOBAL PATROL, this program will help students learn how they can join with Tweety and practice the "Three R's" at home and at school. This packet is a joint effort of the Alliance for Environmental Education, Warner Bros. Inc., and the US Environmental Protection Agency. Unfortunately, we were sent a limited number of these packets so if you do not receive your **Tree Amigos** supplement in one of the Tweety's Global Patrol envelopes (we conserved paper by using their envelopes rather than repackaging everything), you may request kits (one or multiple) from: Tweety's Global Patrol, c/o The Alliance For Environmental Education, P O Box 368, 51 Main Street, The Plains, VA, 22171-0368.

- We have also included a Press Release announcing the First Youth Environmental Summit to be held July 15-18, 1993 in Cincinnati, Ohio. The Summit is designed to engage youth in grades 5-12, nationwide, in environmental issues and concerns. If you have students who are really interested in getting involved as presenters or participants at the Youth Summit please contact Monica Rogers **as soon as possible**. Those students can then be sent a registration application. Summit participants will be selected by the Summit Steering Committee, comprised of 15 youth, based on certain criteria such as "How will the nominee/agency share the Summit experience with other youth upon returning to their community with the skills they learned at the Summit?"

- We will continue to send you additional materials throughout the year. Please let us know what you are doing in your school or group. We would like to feature your activity in our **Tree Amigos** Report, so please send photos and descriptions to the Center in a project report form.

Keep in touch!

Kay and Monica

Kay & Monica

CENTER FOR ENVIRONMENTAL STUDY • TREE AMIGOS PROJECT
143 Bostwick NE • Grand Rapids, MI 49503 • (616) 771-3935 • FAX (616) 771-4005

ACTION PROJECT: Tree Amigos Vocabulary/Vocabulario

OBJECTIVE: To introduce bilingual vocabulary that illustrate the integration of languages and culture.

AGES: Second-Grade through Eighth-Grade

DESCRIPTION: A variety of classroom activities have used the Tree Amigo bi-lingual vocabulary including:

BILINGUAL BULLETIN BOARD: Have students find or draw pictures which represent the bi-lingual Tree Amigo words and decorate a bulletin board with the pictures and words. With the help of a Spanish/English dictionary students can draw their own Tree Amigos picture and find new words.

WORDS WITH SIMILAR ROOTS: Copy the vocabulary list (reverse), then have students guess the missing words that have similar roots or are commonly used in English. Have students list other Spanish words that have become part of common English usage.

WORD SEARCH: Providing students with a bi-lingual dictionary have them look up common words then illustrate with photos or drawings.

TREE AMIGOS

VOCABULARY/VOCABULARIO

TREE..........ARBOL

FRIEND.........____________

____________..........TIERRA

LEAF.........HOJA

ROOT.........RAIZ

WATER.........AGUA

____________.........AIRE

_____________........CONSERVACION

HOME.........HABITACION

______________.....CONTAMINACION

YES........_________

_________.........NO

I LIKE.........ME GUSTA

WORLD.........MUNDO

____________.........MAPA

THANK YOU.........____________

TREE AMIGOS

VOCABULARY/VOCABULARIO

TREE......ARBOL

FRIENDS.....AMIGOS

EARTH.....TIERRA

LEAF.....HOJA

ROOT.....RAIZ

WATER.....AGUA

AIR.....AIRE

ANIMAL.....ANIMAL

CONSERVATION.....CONSERVACION

HOME.....HABITAT

POLLUTION.....CONTAMINACION

YES.....SI

NO.....NO

I LIKE.....ME GUSTA

WORLD.....MUNDO

MAP.....MAPA

THANK YOU.....GRACIAS

ACTION PROJECT: Aluminum Can Collection

OBJECTIVE: *Provides an opportunity for students to learn recycling concepts and tropical forest ecology while raising funds to "adopt" acres of tropical forests.*

AGES: *Pre-school through High school*

MATERIALS: *Collection Boxes; Promotional Flyers (see the following two pages)*

DESCRIPTION: This exciting activity has been conducted in many Tree Amigos classrooms in West Michigan and throughout the United States. Children were encouraged to bring in aluminum cans (and glass and plastic bottles in Michigan). The Michigan Bottle Law passed in the early 1970's, establishing a 10 cent deposit on most effervescent beverage cans and bottles.

Can collection flyers were posted in various areas in the school and a collection center was set up in the school. Students, teachers, staff and administration quickly began filling it. The aluminum cans and glass and plastic bottles were returned to local supermarkets and the deposit money was collected and held by the teacher.

When the can drive was finished the money was donated to The Tropical Forest Fund of the Center for Environmental Study. The donation was designated to go to reforestation projects in Latin America and/or to land acquisition to help preserve and protect acres of tropical forest in Costa Rica.

Over $150,000 to date have been raised through the creative action projects developed by students and educators. Due to the overwhelming success of projects like the can collection activity, students have raised enough funds to enable the Center for Environmental Study to purchase $20,000 worth of acreage in the remote Osa Peninsula of Costa Rica. This land was acquired in June 1992 and will be forever designated The Children's Tree Amigos Forest.

On the following pages you will find two copy-ready posters that can be distributed throughout your school. Help protect the remaining Costa Rican tropical forests and reforest newly acquired park and preserve lands.

EXTRA! EXTRA!

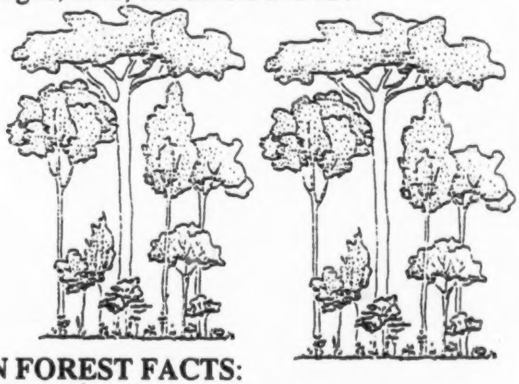
SAVE THE RAIN FORESTS

THIS IS YOUR CHANCE TO HELP! PLEASE BRING YOUR EMPTY CANS TO THE COLLECTION CENTER!

Our school has a chance to help the Earth. The Center for Environmental Study has a program called the **Tree Amigos**. We can raise money for the rain forest by recycling aluminum cans. ***For every $25 we raise, we can help save one acre of rain forest from being destroyed.***

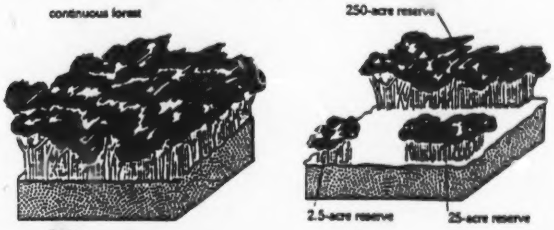
Rain forests are being cut down all over the world. This process is called deforestation. Deforestation affects animals, plants, native peoples, the planet as a whole, and YOU!

Each year, millions of acres of rainforest are lost to ploughs, axes, bulldozers and fire.



RAIN FOREST FACTS:
Rain forests are cut at a rate of 100 acres each minute. An area the size of Pennsylvania is destroyed each year.

More than **50%** of the world's original rain forest cover has **already** been destroyed.



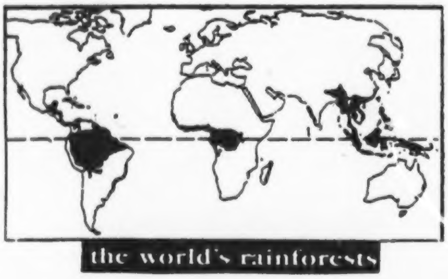
Rain forests cover only 7% of the globe but they are home to 50-80% of the world's plant and animal species.

A full quarter of all prescription drugs are derived from rain forest plants.

Native rain forest peoples around the globe are being forced from their lands, and they are dying from disease and violence.

Cutting down the trees speeds up global warming because trees breathe in CO^2 and then breathe out oxygen for us. When the rain forest is destroyed, the trees can no longer take extra carbon out of the air.

CLEAN UP THE LITTER OUTSIDE. WHEN YOU FIND RETURNABLE CANS, BRING THEM TO THE COLLECTION CENTER AND HELP US SAVE THE REMAINING RAINFORESTS.



the world's rainforests

HELP US SAVE THE RAIN FOREST!

BRING IN EMPTY ALUMINUM CANS.

ONLY 250 CANS WILL PROTECT AN ACRE OF RAIN FOREST!

TREE
AMIGOS

ACTION PROJECT:	*Foods from the Tropical Forests*
OBJECTIVE:	*Learning about tropical forest food products while expressing their creativity through coloring.*
AGES:	*Pre-school through Fourth Grade*
MATERIALS:	*Copies of five copy-ready botanical artwork that follow* *Colored pencils, Crayons, Markers*
DESCRIPTION:	*This activity provides an opportunity for students to learn about some common products that grow in tropical forest areas of Latin America, while expressing their creativity through coloring.*

DIRECTIONS: Prepare students for this activity by reviewing their prior knowledge in regard to the different foods and products that are indigenous to tropical forests. (You may find additional product information in the "Jungle in the Pantry" activity created by Ranger Rick's Nature Scope located in the People and Resources Section of the **Tree Amigos** Resource Book).

You will find complete botanical descriptions of the five tropical plants depicted in the artwork. The descriptions were compiled by Dr. Rick Sullivan of the Center for Environmental Study.

After discussion of the products and foods found in tropical forests and the benefits to everyone in preservation rather than deforestation of tropical forests, distribute the five copy-ready botanical drawings to students. You may also discuss the English, taxonomic and Spanish description of each botanical planted depicted in the drawings.

These beautiful drawings were provided to the Center for Environmental Study by Ms. Barbara Wesholski, PO Box 114, Comstock Park, Michigan, 49321. Barb is a recent graduate of the Arts Division of Grand Rapids Community College in Grand Rapids, Michigan.

TROPICAL FOOD PLANTS

Cacao (*Theobroma cacao*); chocolate

When the Spanish first reached the New World, they found the inhabitants drinking a concoction made from chocolate and flavored with chilis. The explorers tried the drink and pronounced it awful. Eventually, however, chocolate made its way to Europe, and when the Europeans finished adapting the pungent pod to their own tastes -- adding vanilla (also from the New World) and sugar, for instance -- it had earned its Latin name: *Theobroma*, or "food of the gods." Cacao originated on the eastern slopes of the Andes, but today it is grown throughout the tropics. It is a major export crop and has become one of the most familiar and favorite of all foods worldwide.

The cacao is a small tree that needs shade and much rainfall. Typically, it reaches no more than 20 to 30 feet in height; the flowers -- and therefore the fruit -- grow directly from the trunk of the tree.

Coffee (*Coffea arabica*); cafe

Despite its name (*arabica*), coffee originated in Ethiopia. It was introduced to Europe in the seventeenth century, when it immediately became extremely popular. Coffee houses sprang up all over Europe; the famous Lloyd's of London insurance company began as a loose partnership of wealthy businessmen who met in a coffee shop. Although coffee can be grown in a number of climates and elevations, the best coffee comes from middle elevations in areas with a strong seasonal dry period, good soils, and good drainage. The highlands of Colombia and Costa Rica produce some of the world's finest coffee.

The coffee tree is actually a shrub that typically grows no more than 15 feet high. The leaves are a shiny, dark green. The red fruits contain two seeds, which are removed and dried before they are exported or roasted. Much of the work of coffee growing and harvesting is still done by hand.

Papaya (*Carica papaya*)

The papaya is native to Mexico and Costa Rica, but it has been domesticated for so long that it no longer occurs in the wild. The fresh papaya fruit, which may weigh as much as 9 kg, is eaten throughout Latin America; it is also used in making soft drinks, sweets, jams, ice creams and other delicacies. In addition, the papaya is the source of papain, a valuable commodity to industry. Papain is used in meat tenderizers, chewing gum, cosmetics, and many other applications. Papain is obtained from the immature papaya fruits.

The papaya is a small tree (7-30 feet high, typically) that grows very fast and lives only for a short time. It grows well at mid to low elevations in good soil. The flesh of the fruit is yellow to reddish orange.

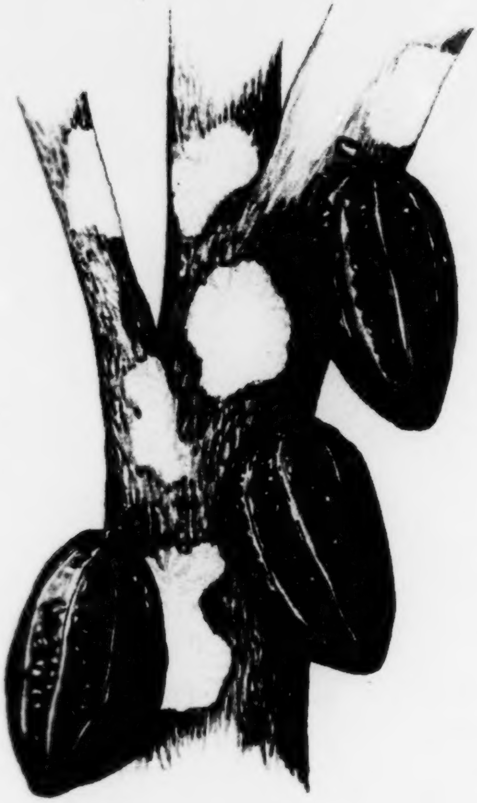
Banana, (*Musa* spp.); platano, banano, guineo

The diverse group of banana plants that we know today (more than 30 varieties) has resulted from the hybridization of two Asian plants. The first bananas grown in the Americas were planted in Hispaniola in 1516. Today, the banana is the most important plant, in economic and social terms, grown in Central and South America.

Bananas are widely grown in back yards and gardens throughout Latin America, as well as in large commercial plantations. The different varieties range from small to large, bland to sweet, and red to yellow, and each is distinct from the others. Commercial bananas in Latin America come primarily from two varieties.

Vanilla (*Vanilla planifolia*); vainilla

The vanilla flavoring so familiar to us all comes from the pods of a climbing orchid plant. There are two species of vanilla, one native to the Americas and the other from Tahiti. Most of the world's supply comes from the Tahitian variety, but in Latin America vanilla is still grown widely, and the New World variety is considered to have a better flavor. The vanilla fruits are harvested when still unripe; at that time they have no aroma. The familiar smell is the result of a curing process. Artificial vanilla, a cheap substitute used in many food products, is a by-product of the wood industry.



Cacao (*Theobroma cacao*); chocolate

Barbara Wesholski
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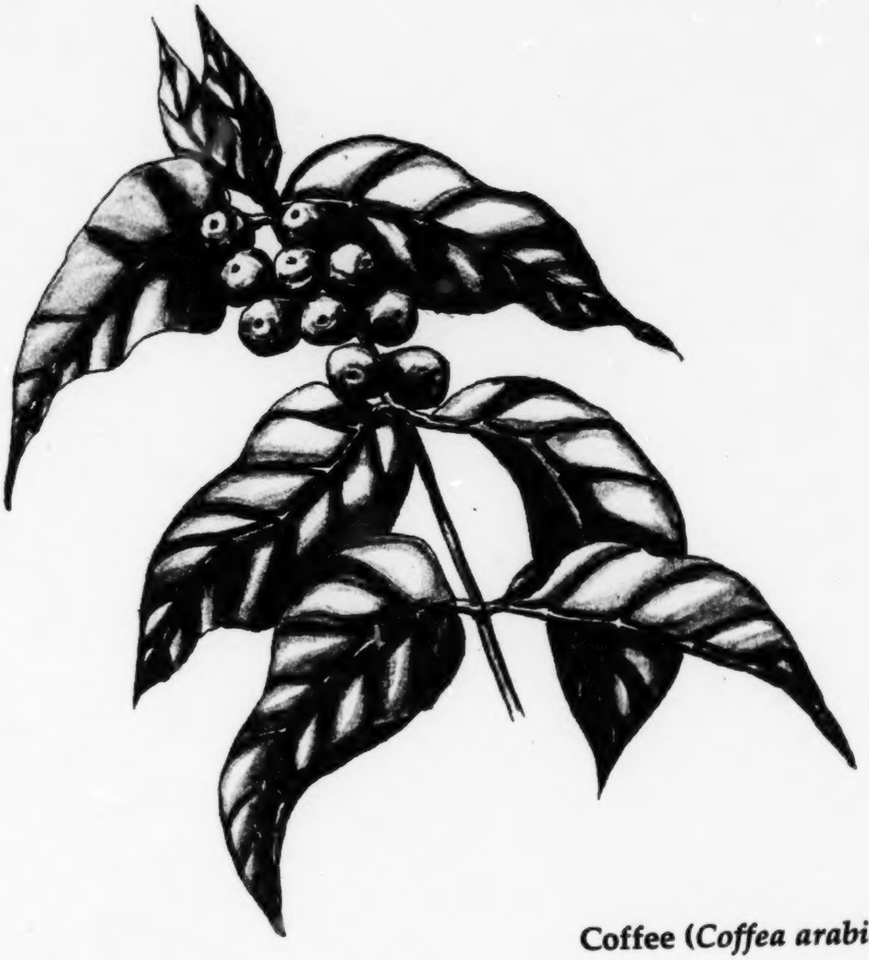
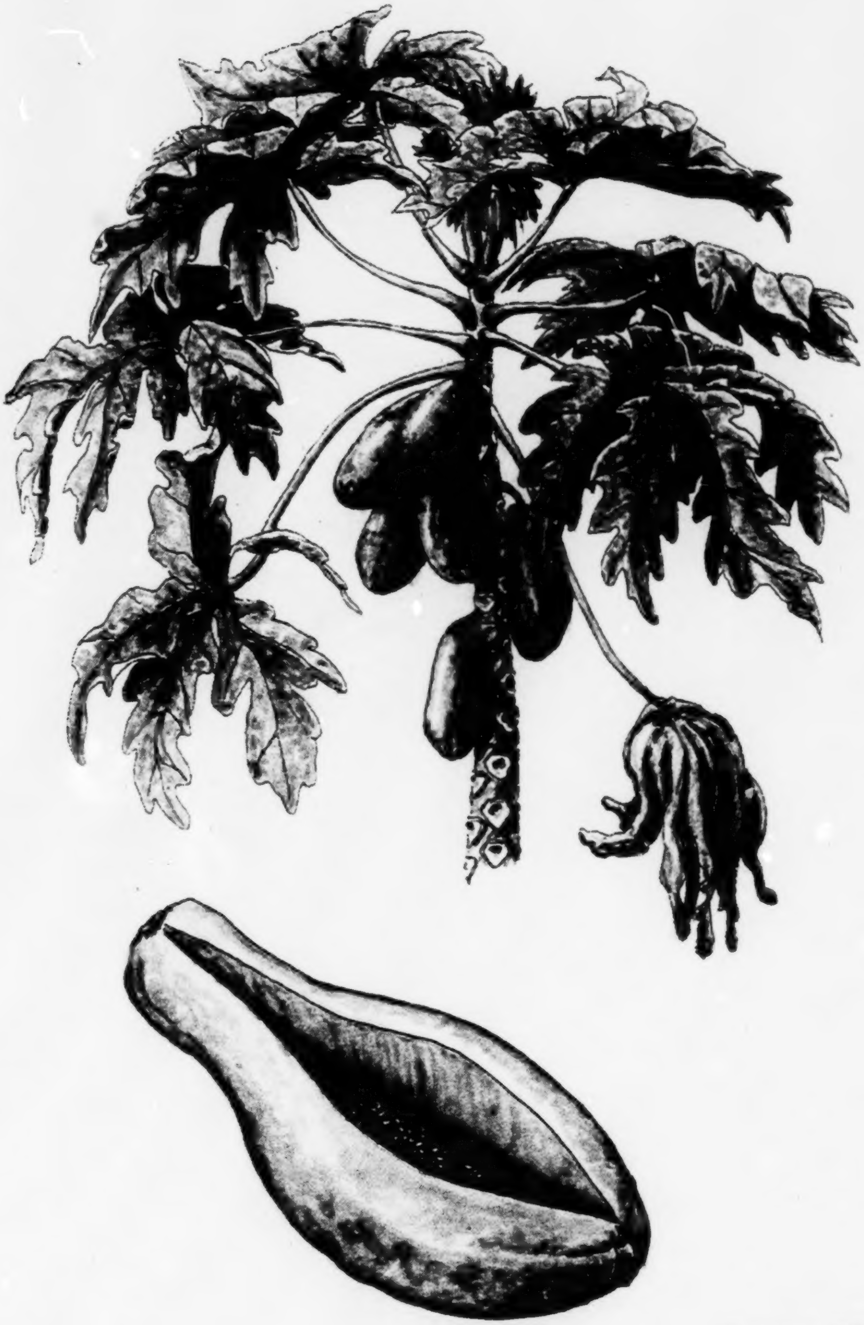
Comstock Park, MI 49321



Coffee (*Coffea arabica*); cafe



Papaya (*Carica papaya*)

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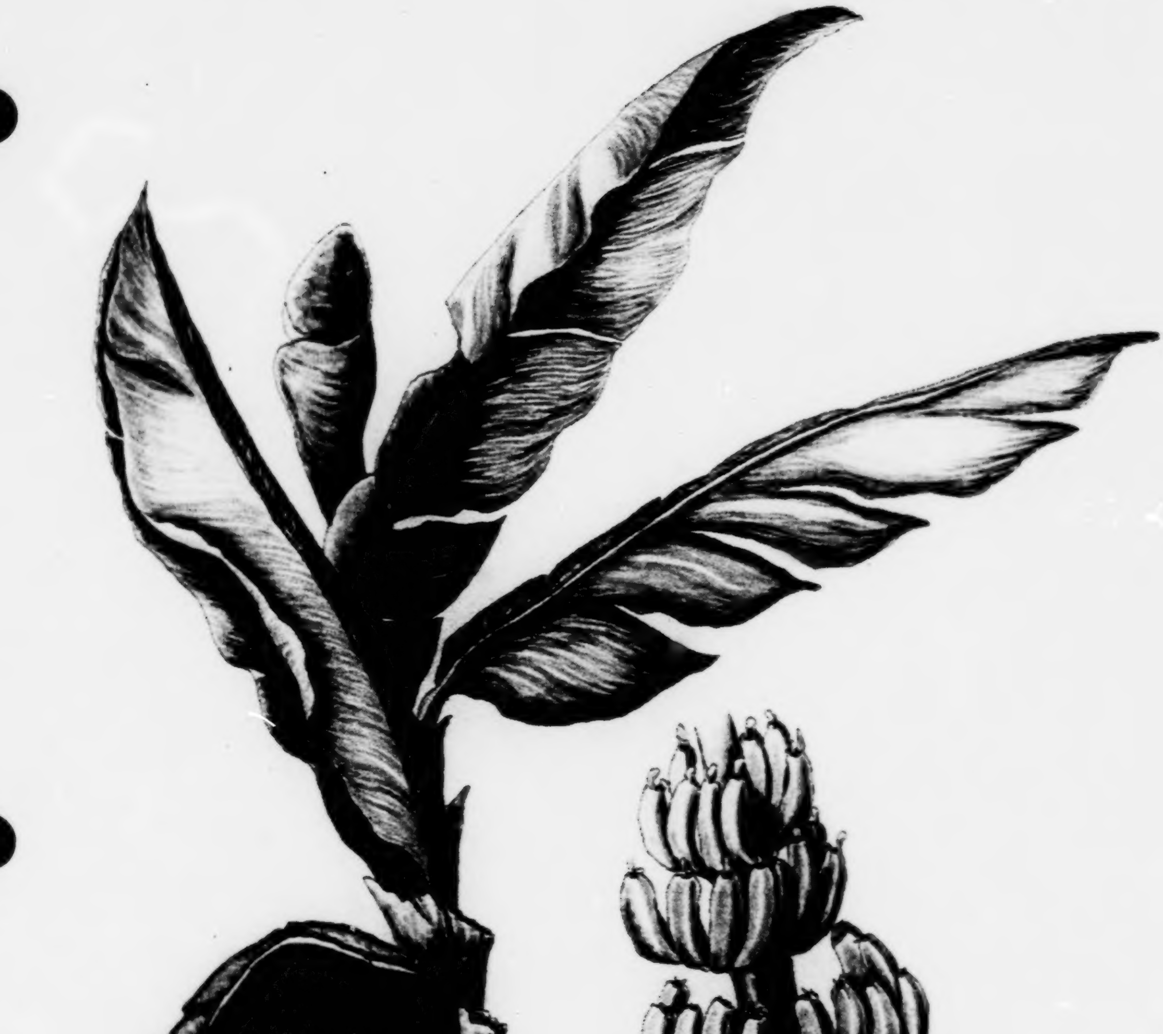

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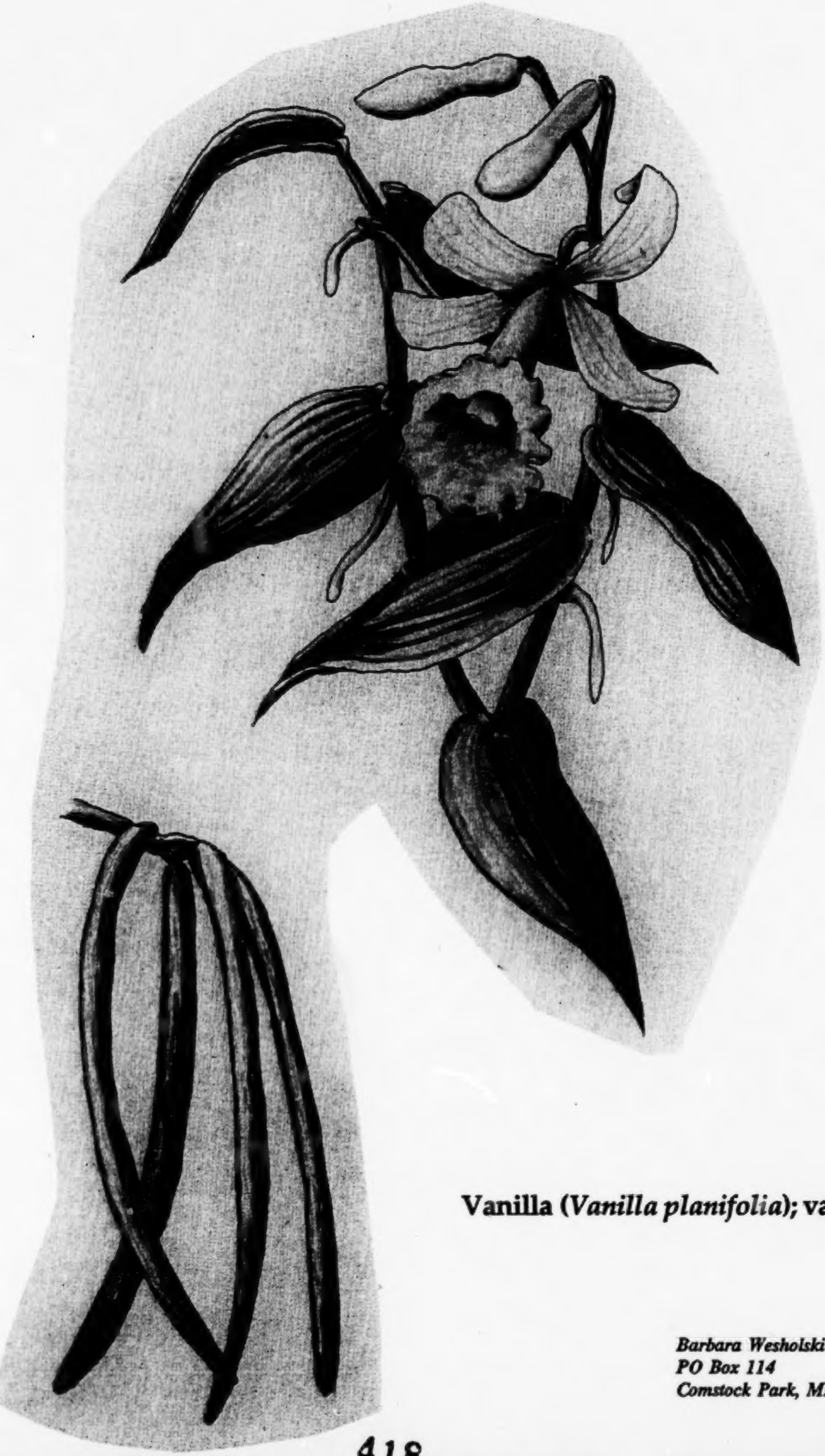
Comstock Park, MI 49321

417 **Banana, (*Musa* spp.); platano, banano, guineo**



Vanilla (*Vanilla planifolia*); vainilla

Barbara Wesholski
PO Box 114
Comstock Park, MI 49321

LEARNING ACTIVITY: *What Kind of Tree Is It?*

OBJECTIVE: *Students are provided an opportunity to learn about four common tree species common to the Great Lakes area while fostering their creativity through coloring copies of the tree species after identification.*

AGES: *3rd through 8th Grade (Tree Indentification Activity)*
Pre-school through Fifth Grade (Coloring Activity)

MATERIALS: *Copy-ready pictures of four species of trees (they follow this activity sheet)*
Coloring pencils, Crayons, Markers
Identification Key that follows this activity sheet

DESCRIPTION: There are many ways to identify trees, but the most common way is to examine the texture of the bark and the leaf shape. Trees are classified according to how they grow, the type of flower and seeds they produce, their internal structure and how they reproduce. This activity will help students identify four common trees by working with a key that guides them by the type of seed and/or leaf each tree produces.

For your convenience, background information on trees is listed on the back of this activity sheet.

- There are two main plant groups that most trees belong to:

Angiosperms: Angiosperms are flowering plants that produce seeds inside their fruit. Tree members of this group include birches, palms, oaks, maples and willows.

Gymnosperms: Plants that produce seeds which are not enclosed in flowers or fruit belong to this plant group. Most gymnosperms produce seeds on the surface of cones. the most common member of this group are pines, hemlocks, firs and spruces.

* GLOSSARY

ALTERNATE - leaves that are staggered or not placed directly across from each other on the twig

BLADE - the flat part of a leaf, or leaflet, characteristic of deciduous trees

BUD SCAR - the marks remaining after bud scales drop in spring

COMPOUND LEAF - a leaf with more than one blade. All blades are attached to a single leaf stem. Where the leaf stem attaches to the twig there is a bud.

CONIFER - cone-bearing tree

DECIDUOUS - shedding all leaves annually

ENTIRE - a leaf margin with smooth, untoothed edges

EVERGREEN - tree with needles or leaves that remain alive and on the tree through the winter and into the next growing season

LOBES - projections that shape a leaf

MARGIN - the edge of a leaf

MIDRIB - the primary rib or central vein of a leaf

OPPOSITE - two or 3 leaves that are directly across from each other on the same twig

PALMATE - leaf blades on one leafstem arranged like fingers on the palm of a hand

PETIOLE - the leafstalk that connects the blade(s) to the twig

PINNATE - leaf blades arranged in leaflets like the vanes of a feather

SAMARA - winged fruit

SIMPLE - a single leaf blade with a bud at one base of the leafstem

SINUS - indentation between lobes on a leaf

SPURS - stubby, often sharp twigs

TEETH - notches on the outer edge of a leaf

- Terms pertaining to trees are adapted from "Teacher/Leader's Guide to Michigan Natural Resources", sponsored by Michigan State Parks and Michigan Department of Natural Resources.

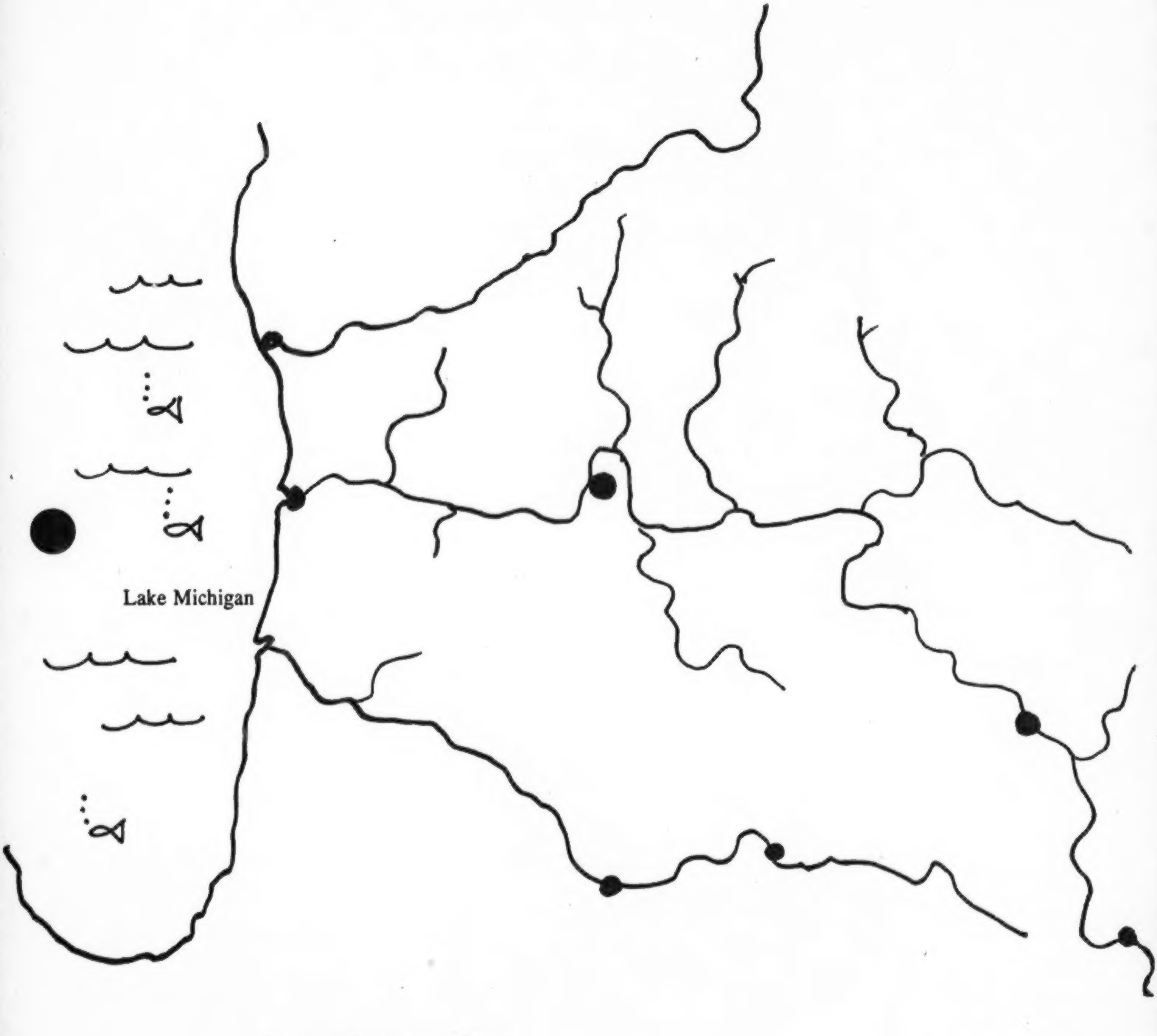
* The glossary is provided by "What Tree Is That?", The National Arbor Day Foundation, 100 Arbor Ave., Nebraska City, NE 68410

WHAT KIND OF TREE IS IT?

Tree Identification Key

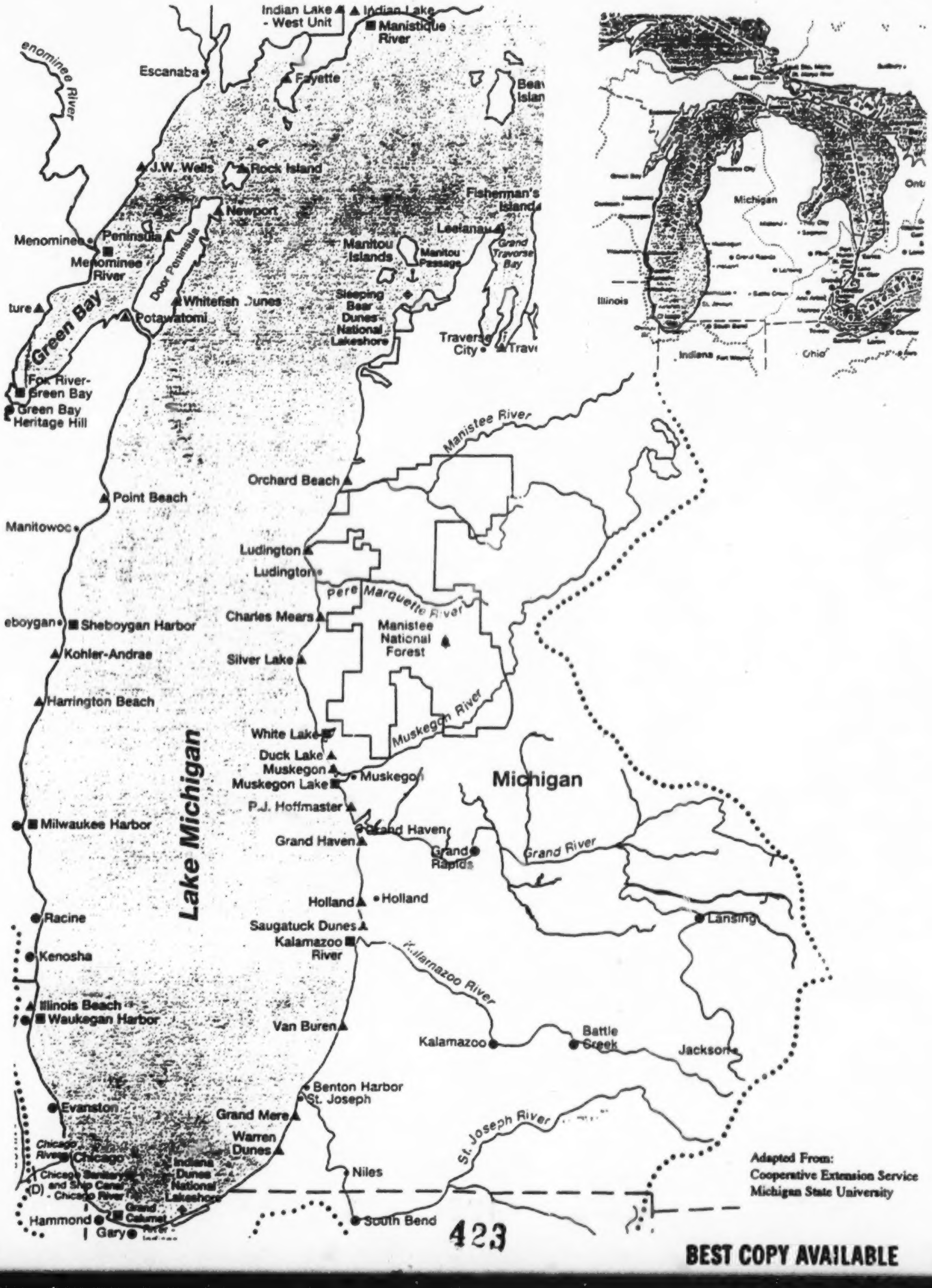
1.	Does the tree produce cones and have leaves that are needle-like? **CLUE:** these trees are called *CONIFERS* (cone bearing) and most are *EVERGREEN* →	**YES, Go to #2**
	OR	
	Does the tree have leaves that are flat and thin and generally shed in autumn? **CLUE:** They bear a variety of fruit and flowers. → → → →	**YES, Go to #3A OR #3B**
2.	Evergreen; coniferous; long needles are clustered in 5's and the cones are long with thin scales.....**WHITE PINE** *(Pinus strobus)*	
3A.	Simple, lobed leaves; in these trees, the blades of the leaves are divided into lobes →	**YES, Go to #4A OR #4B**
	OR	
3B.	Compound leaves; the blades of these leaves are divided into either a few or many separate leaflets → → → → → → → → → → → → → → → → →	**YES, Go to #5**
4A.	Deciduous; fruits are produced in winged pairs that have pale green to brown, slightly, spreading wings. This type of fruit is called a "samara" and all trees in this family have these "propellers"......**SUGAR MAPLE** *(Acer saccharum)*	
4B.	Deciduous; fruits are acorns, egg-shaped which are brown when ripe in autumn with shaggy brown cups covering over one-half of the acorn.....**BLACK OAK** *(Quercus velutina)*	
5.	Deciduous; compound leaf, produces clusters of several thin-shelled, light brown edible nuts enclosed in thick, round husks that are green in the summer and turn brown in autumn. The husks split apart when ripe in autumn.....**SHAGBARK HICKORY** *(Carya ovata)*	

Watershed Activity for Lower Elementary Students


Lake Michigan

Center for Environmental Study
143 Bostwick, NE
Grand Rapids, MI 49503

Watershed Activity for Upper Elementary Students


Indian Lake - West Unit
Indian Lake
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Menominee River
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Fayette
Beav Islan
J.W. Wells
Rock Island
Fisherman's Island
Newport
Leelanau
Peninsula
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Manitou Islands
Manitou Passage
Grand Traverse Bay
Door Peninsula
Green Bay
ture
Whitefish Dunes
Potawatomi
Sleeping Bear Dunes National Lakeshore
Traverse City
Trave
Fox River-Green Bay
Green Bay Heritage Hill
Manistee River
Orchard Beach
Point Beach
Manitowoc
Ludington
Ludington
Pere Marquette River
Charles Mears
Manistee National Forest
eboygan
Sheboygan Harbor
Kohler-Andrae
Silver Lake
Harrington Beach
Muskegon River
White Lake
Duck Lake
Muskegon
Muskegon
Muskegon Lake
Michigan
P.J. Hoffmaster
Lake Michigan
Milwaukee Harbor
Grand Haven
Grand Haven
Grand Rapids
Grand River
Holland
Holland
Lansing
Racine
Saugatuck Dunes
Kalamazoo River
Kenosha
Kalamazoo River
Illinois Beach
Waukegan Harbor
Van Buren
Kalamazoo
Battle Creek
Jackson
Benton Harbor
St. Joseph
Evanston
Grand Mere
St. Joseph River
Chicago River
Chicago
Warren Dunes
Indiana Dunes National Lakeshore
Chicago Sanitary and Ship Canal
Chicago River
(D)
Grand Calumet
Niles
Hammond
Gary
South Bend
Michigan
Illinois
Indiana
Ohio
Ont

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Cooperative Extension Service
Michigan State University

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The Great Lakes Ecosystem

by Rick Sullivan, Ph.D., Center for
Environmental Study

The five Great Lakes —**Superior, Michigan, Huron, Erie and Ontario** — make up the largest system of fresh, surface water on earth. Together they contain almost one fifth of the world's fresh water supply and 95% of the available fresh water in the United States.

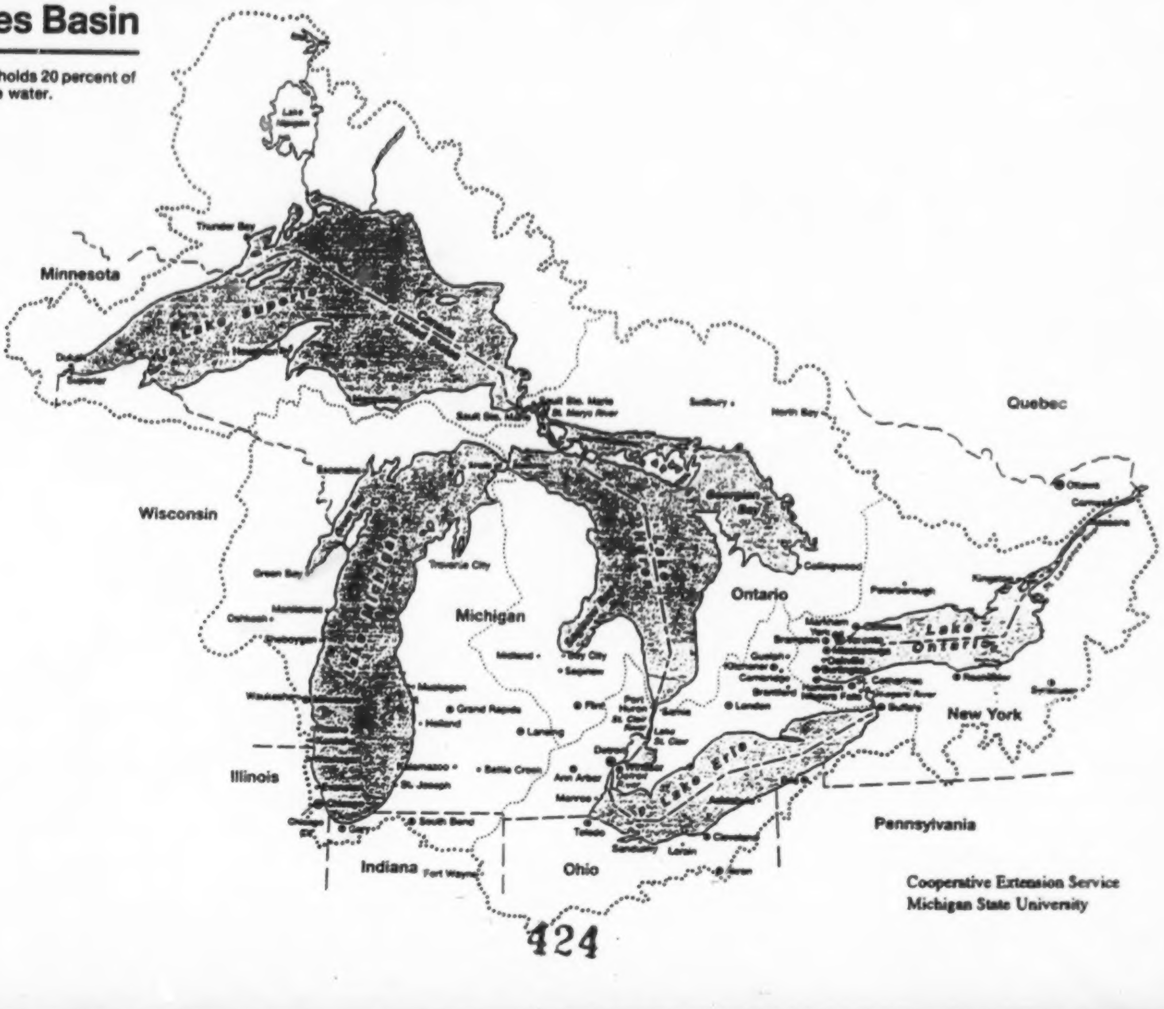
The almost 40 million Americans and Canadians who live in the Great Lakes region use these waters for drinking, home use, travel, power, recreation and many other uses. Only recently, however, have we begun to understand that the lakes are part of a system — the **Great Lakes ecosystem**. That system is more fragile than we knew, and our activities have already done it great harm.

An ecosystem is made up of plants, animals and the part of the physical environment – the air, land and water — with which they interact to produce a cyclic exchange of matter and energy. Ecosystems can be large or small — from a single tree or plant to the entire planet. Large ecosystems contain smaller ones within them. Some ecosystems, such as the deep ocean, are quite simple, while others, like the tropical rainforest, are extraordinarily complex.

The Great Lakes ecosystem is defined by the watershed of the five lakes – the entire area in which water that falls on the ground will end up in the lakes. This includes the headwaters of all creeks, streams and rivers that drain into the lakes.

Great Lakes Basin

eat Lakes system holds 20 percent of
d's fresh surface water.


Thunder Bay
Minnesota
Lake Superior
Duluth
Superior
Sault Ste. Marie
St. Marys River
Sudbury
North Bay
Quebec
Wisconsin
Green Bay
Oshkosh
Sheboygan
Traverse City
Michigan
Midland
Bay City
Saginaw
Muskegon
Grand Rapids
Holland
Lansing
Flint
Port Huron
St. Clair River
Sarnia
Lake St. Clair
London
Detroit
Windsor
Ann Arbor
Monroe
Battle Creek
Kalamazoo
St. Joseph
Illinois
South Bend
Indiana
Fort Wayne
Toledo
Sandusky
Lorain
Cleveland
Ohio
Lake Erie
Erie
Ontario
Collingwood
Peterborough
Kingston
Lake Ontario
Markham
Brampton
Guelph
Kitchener
Cambridge
Brantford
Hamilton
Niagara Falls
St. Catharines
Niagara River
Buffalo
Rochester
Syracuse
New York
Pennsylvania

Cooperative Extension Service
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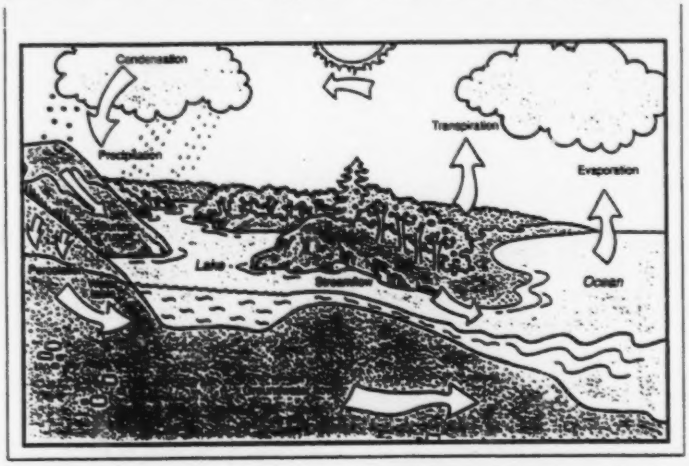
Because it is defined by the movement of water, the system is sometimes called a **flow-through system**. Water enters the system as precipitation – rain or snow. Some of it falls on the lakes themselves, while the rest falls within the drainage area of the lakes. From the surface, it enters the lakes through runoff, rivers, streams and groundwater. It flows through the lakes and then flows out through the St. Lawrence River and eventually to the Atlantic Ocean. All along its journey, some of the water is constantly lost to evaporation from lakes or ground, or to water vapor given off by living plants and animals.

Evaporated water enters the air and eventually falls again as rain. This closed cycle of water movement — rain, evaporation and then rain again — is known as the **hydrological cycle**.



Environment Canada

There are advantages and disadvantages to a flow-through system. In the case of the Great Lakes, these characteristics are magnified by the sheer size of the system.

On the one hand, a flow-through system can clean itself, if it is not overloaded with pollutants. Recharge of the lakes is constant, with the hydrological cycle constantly providing fresh water. At the other end, the St. Lawrence River provides an escape: many pollutants can be carried out of the system. They will end up in the oceans, of course, but they will at least be removed from the Great Lakes.

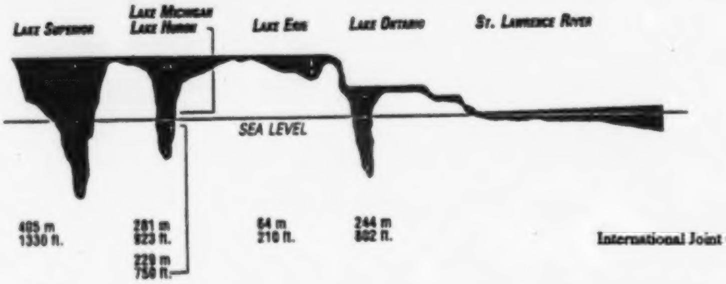
On the other hand, there are also serious problems in a flow-through system. One of these is that any pollution put into the system will be carried downstream, affecting each succeeding area as it moves through. Mercury dumped into Lake Superior will eventually make its way through Superior, Huron, Erie and Ontario before being picked up by the St. Lawrence. This also applies to substances dumped or buried in the ground, such as in urban or industrial areas, and to pesticides, fertilizers and soil from farms. They can enter the ground water or be picked up by runoff water, and be carried eventually into the lakes.

Furthermore, since everything in the system is connected, it is fairly simple for an exotic species, such as the sea lamprey or the zebra mussel, to find its way upstream and – in the absence of natural enemies – to proliferate, killing off or driving out native species.

Water levels in the Great Lakes fluctuate naturally over time, a fact not always appreciated by owners of waterfront property, who would like to see the lakes controlled and managed to protect their investments . In recent years, two artificial diversions – one at Chigaco and one at Ogoki-Long Lac in Canada – have provided additional outlets for lake water. The issue of lake water diversion is becoming increasingly significant as other parts of the country, facing water shortages, look toward the apparently inexhaustible supply in the Great Lakes . However, our previous alterations of the Lakes ecosystem have demonstrated the dangers of attempting to change the system for our own purposes. Instead, we must learn to anticipate and live with natural changes.

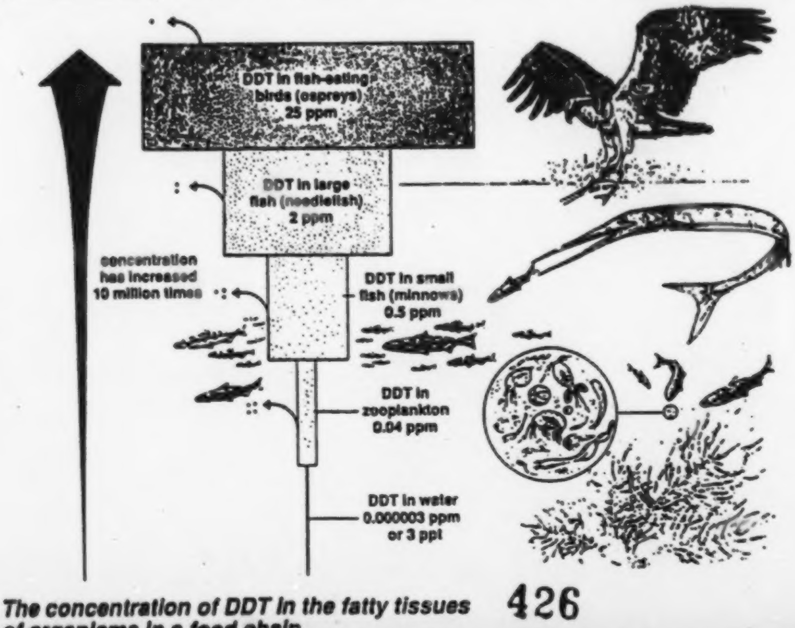
Except for Lake Erie, the turnover rate – the rate at which water enters and leaves the system – is very slow in the Great Lakes. The water in Lake Erie turns over in about six years, but it takes approximately 191 years for the water in Lake Superior to replace itself. The average turnover rate for all the lakes is less than 1% per year . . . the equivalent of trying to drain a sink that is 99% blocked. This means that pollutants put into the system will probably stay there a long time, and any attempt to clean the lakes will not show immediate, dramatic results. A profile of the lakes makes it clear why turnover is so slow.

LAKE LEVELS PROFILE


LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO
ST. LAWRENCE RIVER
SEA LEVEL
405 m
1330 ft.
281 m
923 ft.
229 m
750 ft.
64 m
210 ft.
244 m
802 ft.

International Joint Commission

When scientists talk about water pollution in the Great Lakes, they often speak about pollutants occuring in parts per million (ppm) or parts per billion (ppb) – in other words, one part of pollutant to one billion parts of lake water. This may seem harmless enough at first glance, but it is not. The reason that such seemingly small amounts of toxics can have major effects on the Great Lakes ecosystem is that they go through a process called **biomagnification**. The relationships of different species to each other in an ecosystem are often represented by a diagram called a **food chain** or a **food web**. At the bottom of the chain are the animals that depend only on sunlight, water and minerals for their existence. Each higher level in the food chain feeds on the level or levels below it, as shown in the diagram below. The lowest animals on the food chain, the zooplankton, absorb poisons from the water; the levels of toxin build up with the amount of water they process through their systems – a process called **bioaccumulation**. Each higher link in the food chain absorbs progressively higher amounts of toxins as it ingests numerous bodies of the animals below it. Thus, the concentration of poison in an animal high on the food chain may be thousands or even millions of times as high as in the water: the animals it has eaten – and the animals they have eaten, and so on – have acted as collectors, or accumulators, of the toxins.


DDT in fish-eating birds (ospreys) 25 ppm
DDT in large fish (needlefish) 2 ppm
concentration has increased 10 million times
DDT in small fish (minnows) 0.5 ppm
DDT in zooplankton 0.04 ppm
DDT in water 0.000003 ppm or 3 ppt

Courtesy of:
Living for the Environment
and Environmental Science;
Transparency Masters

The concentration of DDT in the fatty tissues of organisms in a food chain.

Everything in an ecosystem is interconnected; when you alter one part, no matter how small it seems, you run the risk of affecting other parts. That is what happened in the 1950's with a seemingly insignificant insect called the mayfly. The story of the mayfly is a good example of how all parts of an ecosystem are connected.

As the area around Lake Erie became more and more developed, massive amounts of fertilizers and other nutrients were washed from surrounding lands into the lake. Tiny water plants called algae capitalized on the newly-available nutrients and grew rapidly to enormous numbers. When these plants died and sank to the bottom of the lake, they were decomposed by bacteria. The bacteria needed oxygen to decompose the plants, and as the plants increased and died in larger numbers, the bacteria pulled more and more oxygen from the lake water. Eventually, the water became so poor in oxygen that the mayfly nymphs, which live on the bottom of the lake, were suffocated.

When the mayfly nymphs died, the fish that had fed on them began to die, also. When the nymphs didn't hatch into adult mayflies, the numerous fish that fed on the mayflies also disappeared. Birds that had fed on the mayflies or on the fish became scarce, as well. Even now, four decades later, the fish population in the lake is quite different from what it was before the die-off of the mayflies. It was only when the mayfly was gone that people realized how important it had been to the wildlife of Lake Erie. All it took was one change in the ecosystem — the addition of extra nutrients — to start a whole chain of events that ended in an ecological disaster.

Today Lake Erie, once considered a dead lake, has partly recovered, but the entire Great Lakes ecosystem faces grave threats from pollution. Industrial products, municipal wastes, fertilizers and pesticides from farms – all are carried into the lakes by ground water, runoff or streams. In addition, huge amounts of pollutants are carried throught the air and deposited on the lakes' surfaces, sinking into the water and adding greatly to the pollution load. We now must vastly expand our scope from considering the watershed of the Great Lakes to considering the airshed. Dealing with these problems will require a massive effort on the part of business, government, conservation organizations and individuals.

Problems for Discussion:

1) Part of the problem in managing the Great Lakes ecosystem is that the system falls within the jurisdiction of two countries – Canada and the United States. Within those countries, two provinces and eight states also have some jurisdiction over parts of the system, and below that level are local and municipal governments. What does this situation mean relative to attempts to manage the Great Lakes ecosystem wisely?

2) Another factor in the complex Great Lakes system is the large number of special interests – often conflicting – who want a voice in the management of the lakes. They range from chemical companies to fishermen, from power companies to conservation groups, and from scientists to politicians. How can these many viewpoints be reconciled with environmentally sound management of the Great Lakes?

3) Many other areas have chronic water shortages and they see a solution to their problems in the diversion of water from the Great Lakes. What are some of the problems that might arise from such schemes?

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(Ed. note; The following bibliography was compiled by Barbara A. Reed, an educational consultant. She can be reached at 847 Baker Street, Lansing, MI 49810, USA; Telephone: (517) 487-5163.

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Center for Environmental Study

Centro de Estudio Ambiental

PRESS RELEASE

FOR
IMMEDIATE
RELEASE: November 25, 1992

FOR MORE INFORMATION
Contact: Monica Rogers
(616) 771-3935

Youth Environmental Summit Planned

The seeds of a children's environmental network will be planted next July 16-18 in Cincinnati, Ohio, at the first National Youth Environmental Summit (YES), with the help of a Grand Rapids seventh grader and the **Tree Amigos** program. The summit will focus on trees, forests and related issues.

Fourteen representatives of the youth environmental movement met recently in El Segundo, California as a steering committee to plan the summit, which will have as its theme "Partners for the Planet Branching Out." The summiteers, as they are known, range from grades 5-12 and represent a geographic, cultural and economic cross-section of America. Altogether, the group represents more than 100,000 members of youth environmental groups in all 50 states and 32 foreign countries.

The 1000 delegates will carry the Summit message out to America's communities and the estimated 10 million young environmental activists.

Despite their different backgrounds, the summiteers had more than their environmental interests in common. "Even though we were from different parts of the country and different ages, we found out that we're all alike," said **Tree Amigo Marisol Cruz**, a seventh grader at Grand Rapids' Burton Center for Environmental Science.

Tree Amigos, a program of the Center for Environmental Study, is one of the summit sponsors. **Tree Amigos** will be planning the Ice Breaker Reception at the summit on the evening of July 15. The reception will have a tropical theme.

Other sponsors include Tree Musketeers (CA), Arbor Club (VA), Assoc. Oregon Forestry Clubs, Natural Guard (CT), Kids F.A.C.E. (TN), YES! (CA), CAPE (TX), Kids S.T.O.P. (NY), Conservation Career Development Program (CA), Minnesota Conservation Corps (MN), and Earth Kids (OR). Each of the summiteers is accompanied by an adult partner from his or her organization or from the Environmental Protection Agency, USDA Forest Service, International Society of Arboriculture, Natural Resource Conservation Education Program, National Association of State Foresters or Environmental Promotions, Inc. Initial funding for the project was granted by the USDA Forest Service.

TREE AMIGOS

"Just imagine," said elated Tree Musketeer Tara Church after the first meeting, "I was only thinking out loud a year ago when I dreamed up a national kids' conference. I never imagined it would be this big, or this important to so many people."

end

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A conceptual framework for environmental education

1. The natural environment

A. **The sun is the major source of energy for most life forms.**
   1. Solar energy is used to maintain ecological processes and to power biogeochemical cycles.
   2. Solar energy is converted by plants and stored as organic material and fossil fuels.
   3. Energy can neither be created nor destroyed; however, energy can be changed from one form to another.
   4. Energy does not cycle. It flows through the environment and is constantly degraded.
   5. High quality (concentrated) energy tends to be nonrenewable, low quality (dilute) energy tends to be renewable.

B. **The materials needed to support life move through the environment in biogeochemical cycles.**
   1. Water, oxygen, carbon, nitrogen, phosphorus and sulfur are examples of chemicals that flow through the environment.
   2. People often use these resources faster than they can be replenished and/or renewed by natural processes.
   3. Replacing or substituting the services provided by natural biogeochemical cycles is energy and material intensive.

C. **The environment is being continually shaped by natural and human forces.**
   1. Abiotic factors determine the variety and quantity of life that can be supported.
   2. The biotic community of microorganisms, plants and animals adapt to the local environment.
   3. Natural forces such as wind, water, and geological activity shape the environment.
   4. Healthy communities have a diversity of organisms that provide stability. People tend to simplify communities.
   5. The activities of organisms tend to change the environment. Human activities tend to cause great changes.

D. **The natural environment functions according to evolved relationships between living and nonliving things.**
   1. Because of energy and material relationships, the biotic and abiotic components of ecosystems are bound together and interact with

III. People and resource management

A. **People can manage renewable and non-renewable resources to meet their needs and the needs of other life forms.**
   1. People historically have managed natural resources for their benefit.
   2. Population growth and the increasing demand for resources are affecting the quality of the built and natural environments.
   3. Proper resource management is complex, especially when many governments and/or corporations are involved.
   4. When some resources become scarce, substitutions may be developed.
   5. The use and misuse of resources affects all life forms.

B. **Conservation includes the use, management, and protection of natural resources.**
   1. Non-renewable resources are important for maintaining our lifestyles.
   2. Economic, social, and legal means can be used to promote the conservation of resources.
   3. Methods of resource conservation include substituting, preserving, reusing, recycling, reclaiming and reducing the amount people use.
   4. There is no such thing as waste, only resources that are not being managed properly. The misuse of resources results in pollution.
   5. People can conserve natural resources by using only what is needed as efficiently as possible. Needs are different in different cultures/societies.

C. **Renewable resources can be managed so they will provide consistent and continuous supplies.**
   1. Renewable resources should be used no faster than they are replenished by natural processes.
   2. Technology plays an important role in renewing and recycling resources.
   3. Through technology, people expand the range of resources used to meet their needs and desires.
   4. Long-range planning for resource management is critical to future supplies.

each other.

2. All living things help maintain and renew the natural environment.

E. Plants and animals live in habitats; many species exploit more than one habitat to meet their needs.

1. Different species of plants and animals depend on specific types of habitats for survival. Florida has many habitats with unique organisms.
2. Each ecosystem needs resources such as water, air, minerals, and energy to maintain life.
3. All habitats have a carrying capacity; if that is exceeded, the habitat may be damaged.

II. The built environment

A. The built environment depends on resources from the natural environment.

1. The built environment requires continuous supplies of energy and materials from the natural environment.
2. People manipulate and cultivate the natural environment to ensure consistent and continuous supplies of energy.
3. Technology expands the geographic area from which people obtain energy and materials.

B. The design and maintenance of human environments reflect and influence the values, ethics, and lifestyles of the inhabitants.

1. Geographic location, space, aesthetics, and people interact in the built environment.
2. Technology and industry have contributed to the development and maintenance of modern cities.
3. Individual and societal values influence the design of the built environment.

C. Built and natural environments function in similar ways and have similar needs for survival, maintenance and growth.

1. Continuing supplies of resources are essential for the maintenance of life in both natural and built environments.
2. The built and natural environments are continuously interactive. Change in one can cause changes in the other.

IV. Social issues and decision-making

A. Environmental problems transcend political entities, state and national boundaries and cultural differences.

1. Technological advancement and industrial expansion throughout the world are creating changes in the world's environment.
2. Population growth and lifestyle decisions are creating an unprecedented demand for natural resources.
3. National self-interests and social values influence international cooperation on environmental issues.

B. Social goals usually include economic prosperity and living in a healthy environment.

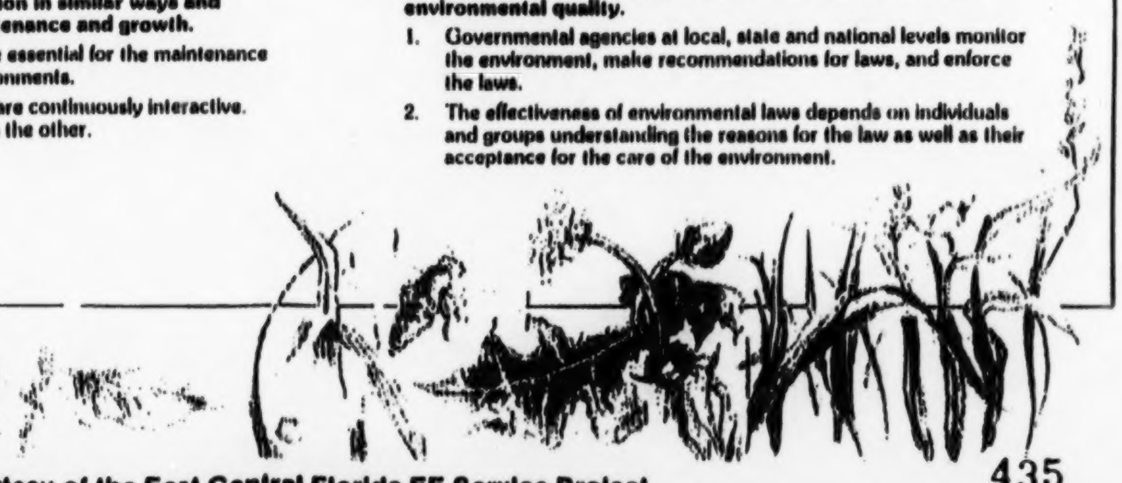
1. Special interest groups express the values, ethics, and understandings of people.
2. Special interest groups participate in the political process and influence public policy.
3. Short-term and long-term planning influence economic decisions related to the use of the environment.

C. Educational institutions and communications media are potential sources for the creation of public awareness about environmental issues.

1. Environmental education is a life-long process that results from in-school and out-of-school experiences.
2. Communications media can, through reporting, advertising and other programming, influence public attitudes about the environment.
3. A variety of public and private organizations provide educational programs about the environment.
4. Various avenues are available for individuals to express concern about the environment.

D. Laws regulate the use of the environment and try to ensure environmental quality.

1. Governmental agencies at local, state and national levels monitor the environment, make recommendations for laws, and enforce the laws.
2. The effectiveness of environmental laws depends on individuals and groups understanding the reasons for the law as well as their acceptance for the care of the environment.



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